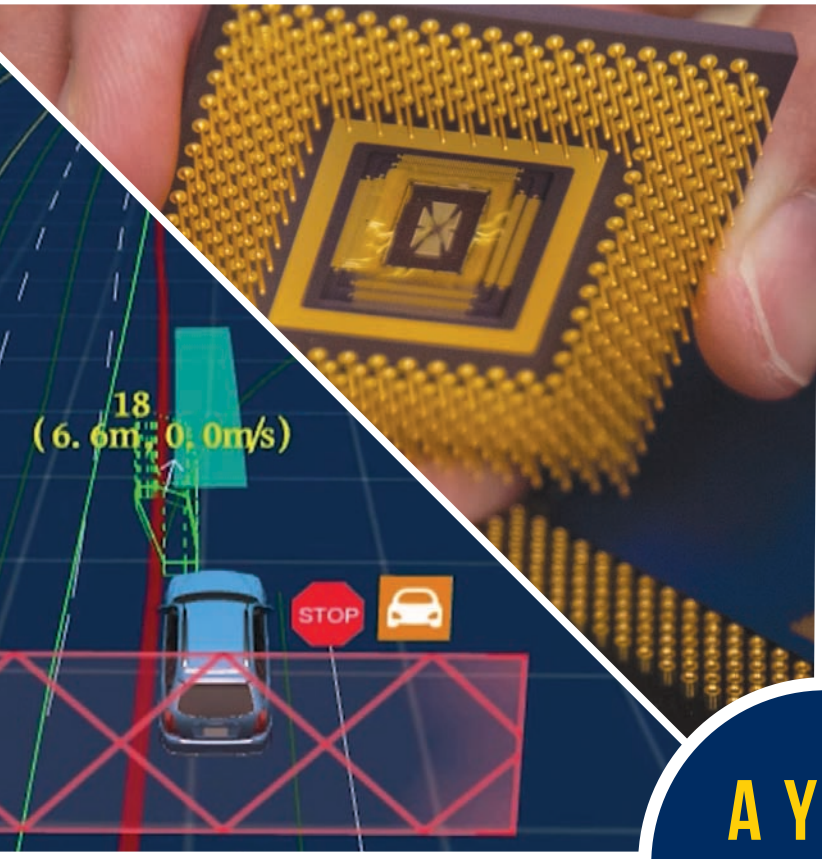
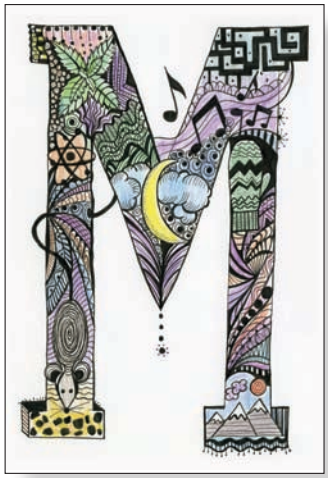
EECS ELECTRICAL ENGINEERING AND COMPUTER SCIENCE
UNIVERSITY OF MICHIGAN



A YEAR IN REVIEW



Artwork by Rose Anderson

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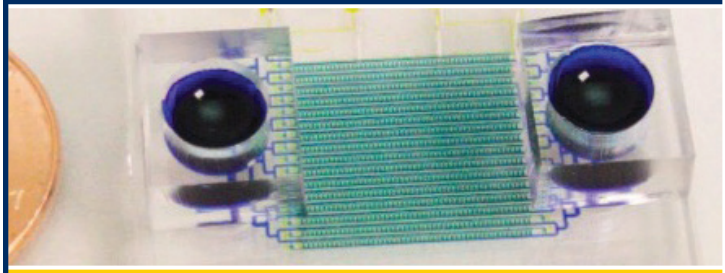

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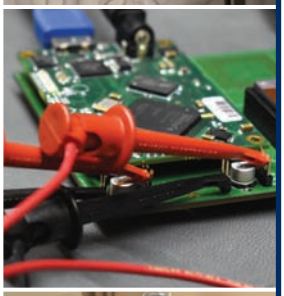

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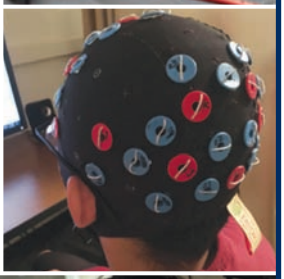

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MESSAGE FROM THE CHAIRS

Mingyan Liu, Chair
Electrical and Computer Engineering

Brian Noble, Chair
Computer Science and Engineering

Dear Friends,

The new academic year has begun, and we are delighted to have our new and returning students in the halls and in our classrooms. We are committed to their success as we continue to expand our academic and research initiatives and deepen our footprint in society. We are happy to bring you the latest news from EECS at Michigan, showcasing what we've done this past year.

One key area is our activity in power and energy. The world is increasingly impacted through severe weather events, brought on largely by our changing climate. Our faculty and students are finding ways to increase our ability to use and produce energy in sustainable ways, including leading a new presidential Commission on Carbon Neutrality.

Automation is being introduced into all facets of our lives at an increasing pace – largely enabled by the devices, control, and algorithms of researchers in electrical engineering and computer science. In just one exciting example, automation is bringing paraplegics the realistic option of walking with the help of external exoskeletons. This level of sophistication in automation, partially enabled through advances in machine learning, has sparked a renewed interest in artificial intelligence, and an expanded view of the field.

But do we really want automation to be pervasive in our lives? And how can we trust autonomous systems to act ethically? These questions consume electrical engineers and computer scientists alike – and are discussed in the context of a new series of community events called Friday Night AI, held at the Ann Arbor Public Library and recorded for viewing online.

We are delighted to welcome eleven new faculty to the department. With expertise focused on programming, automation (robotics, computer vision, control), and information science, we are excited to see what they will bring to Michigan and contribute to the betterment of society.

Eight of our young faculty have earned ten early career awards, including five NSF CAREER Awards, four Young Investigator Awards, and a Sloan Research Fellowship. We congratulate these faculty for receiving such notable endorsements of their research and promise.

Gérard Mourou, the A.D. Moore Distinguished University Professor Emeritus of Electrical Engineering and Computer Science, was one of three winners of the 2018 Nobel Prize in Physics for "groundbreaking inventions in the field of laser physics." He is the 25th Nobel Prize winner from the University of Michigan, and the first from our Department. Read more about this great honor and many more honors and accomplishments of our faculty in this issue, including a new IEEE Field Award and three new professorships.

Remember those days as a student? It can be an accomplishment just to survive the coursework. We want our students to not just survive, but to thrive and expand their horizons. Read about just a few of the activities being undertaken by today's students in and out of the classroom. Whether developing an in-course app to aid in operating rooms, or traveling to Nepal to install solar panels, they are using their engineering skills in service to society.

In line with the University of Michigan and the College of Engineering, the EECS Department is strongly supportive of a friendly, diverse, and equitable environment for all its faculty and staff. We have led highly successful programs in support of women in computing and engineering, and continue to offer a wide variety of events that highlight different cultural traditions around the world. Our support of Spirit Day reflects our desire to end bullying in all its many forms.

Our alumni are our pride and joy! This year we focus on just a few, with longer profiles on our website. We welcome all of you to send your accomplishments, large and small.

Until we meet again – be well and Go Blue!

RESEARCH BRIEFS

WORKING TOGETHER FOR A GREEN FUTURE

Faculty and students in the EECS Department have a deep commitment to creating a sustainable future for all. Following are some of the ways they are helping to create this future.

Could Windows Power Cities?

A new $1.3M project spearheaded by Prof. Stephen Forrest is working to turn windows into efficient solar cells that could provide power to entire buildings, and maybe one day, cities.

Forrest's group has already developed thin, transparent, photovoltaic sheets that can be placed over windows with no reduction in clarity, thanks to the use of organic photovoltaics. These sheets could transform the 50-70% of sunlight that is normally reflected by windows into energy. Forrest and his team have already achieved 8% efficiency in the lab, and plan to reach nearly 15% with 50% transparency in this new project.

The project is funded by the Department of Energy's Solar Energy Technologies Office, which is funding new projects that are improving the affordability, flexibility, and performance of solar technologies on the grid, while creating the solar workforce of the future.

Manufacturing Sustainable Lighting

A new $1.6M research project funded by the Department of Energy is bringing the promise of energy efficient and flexible lighting options to the nation's buildings and your living room.

Capitalizing on past research in organic light-emitting-diodes (OLEDs) and advanced manufacturing techniques for organic solar cells, Prof. Stephen Forrest and his team are developing a high yield, automated process to manufacture white organic solid-state lighting devices that will come off the presses like sheets of newspaper.

With about 25% of all electricity in the U.S. going to lighting, taking advantage of highly-efficient OLED technology in the world of lighting could result in huge energy savings. After overcoming most of the technical barriers in using OLEDs for general lighting, Forrest is now partnering with industry to develop a fast and efficient manufacturing process.

Air Conditioners Could Advance a Renewable Power Grid

Power plants continuously ramp up and down to produce enough electricity to meet demand. However, renewable energy sources such as solar and wind are highly variable, and that can make it difficult for traditional power plants to maintain this supply-demand balance. With the goals of improving the overall efficiency and reliability of the power grid while making the grid adaptable to renewable energy, Profs. Johanna Mathieu and Ian Hiskens aim to take strategic control of air conditioners.

“The goal of the project is to use air conditioners to provide the balancing support that the renewables need, so you can have more renewables on the system without affecting the consumer,” Mathieu says.

By changing when air conditioners cycle on and off, the researchers believe they can better balance energy from renewable sources.

“Many papers have been written on this topic, but real-life, large-scale implementation has not previously been attempted. We have an opportunity to explore how this really works in practice,” says Ian Hiskens, the Vennema Professor of Engineering.

The project is funded by a $2.9 million grant from the Advanced Research Projects Agency-Energy (ARPA-E). The U-M team is partnering with the Los Alamos National Laboratory (LANL), the non-profit research and development organization Pecan Street, Inc., and the University of California, Berkeley.

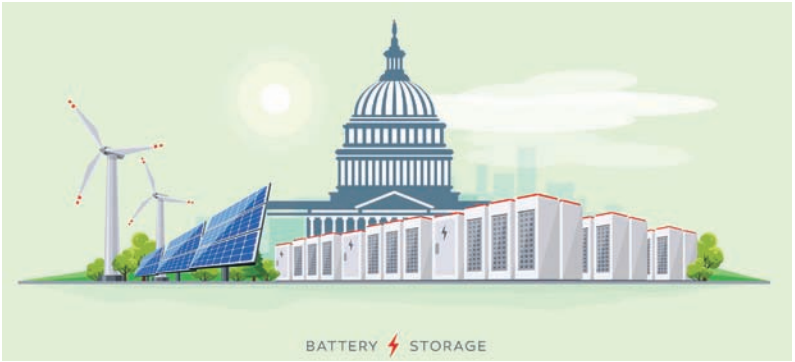
Can Batteries Make the Nation’s Grid More Sustainable?

Prof. Johanna Mathieu and Prof. Catherine Hausman (School of Public Policy) are heading a new project funded by the Alfred P. Sloan Foundation to evaluate the impact of batteries on the electrical grid. This research has the potential to help guide future energy policies and investment in battery storage, especially in the area of renewable energy.

“We’re estimating how increasing the number of batteries on the system may change the mix of energy generation in the future,” said Mathieu. “The goal is to determine how to change policy so that battery storage achieves both our environmental and economic goals.”

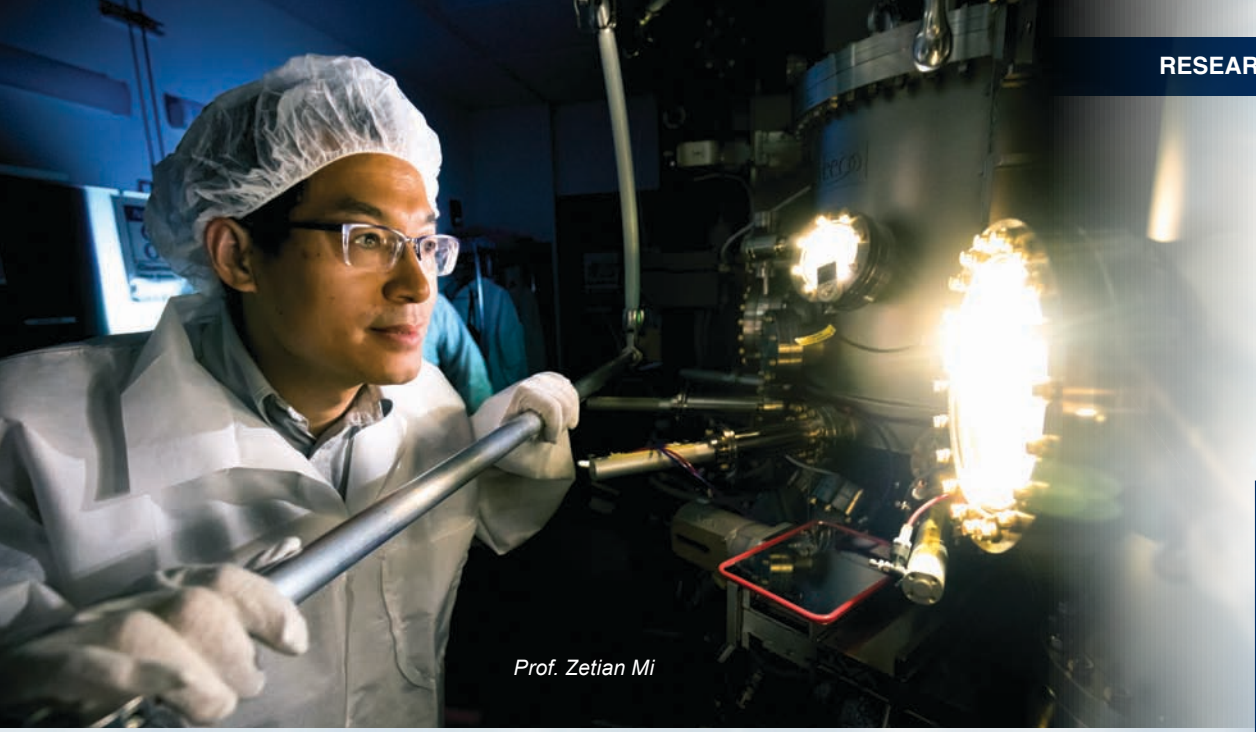
Prof. Hausman will analyze data from the largest electricity market in the Northeast, the PJM Interconnection, which has had a significant growth in battery storage. She will use statistical tools and data-driven approaches to examine the effects this growth has had on the economics of the electrical grid and other generating units, and examine how past policies and technologies affected the energy infrastructure.

Prof. Mathieu will use the data from PJM to examine how increased battery storage affected PJM’s ability to integrate renewable energy, and then predict how future grids may operate. Mathieu and Hausmann will also design new storage policies to meet the need of increasing renewables on the grid.



Sustainable Semiconductor Manufacturing

Prof. Becky Peterson is leading a project to develop an environmentally-friendly manufacturing method for semiconductor films used in high-power devices. Her team aims to use crystalline gallium oxide films in electronic devices to improve their efficiency while reliably supporting the higher voltages required for applications where silicon falls short.



Prof. Zetian Mi

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Pallab Bhattacharya
Mackillo Kira
Pei-Cheng Ku
Zetian Mi
Ted Norris

Materials Science and Engineering:
Emmanouil Kioupakis
Robert Hovden

Mechanical Engineering:
Kevin Pipe

Chemistry/Biophysics:
Kevin Kubarych

Physics:
Steven Cundiff
Jennifer Ogilvie

Quantum Engineering for Clean Water and Sustainable Energy

Prof. Zetian Mi is leading a large multidisciplinary team seeking to develop new ways to control and use quantum particles such as excitons, polaritons, and dropletons to improve life for all. Quantum engineering could lead to improving the efficiency of using ultraviolet LEDs to purify water by a factor of 10 to 100, and help the 2.5 billion people in the world who don't have regular access to clean drinking water.

The researchers are also focused on creating a new source of renewable fuels through artificial photosynthesis. Through quantum engineering, gallium nitride can be turned into one of the most efficient photocatalysts for solar hydrogen generation. Mi envisions harnessing the unique quantum properties of gallium nitride to demonstrate artificial photosynthesis that can convert atmospheric carbon dioxide and water into fuel with an efficiency that bests plants by 10 to 100-fold.

The research is funded by the College of Engineering's Blue Sky Initiative, which funds projects that are high-risk high-reward and tackling some the biggest issues in the world today.

How to Convert a Traditional Engine Into a Hybrid

Prof. Heath Hofmann is part of a team collaborating with engine-developer Achates Power on a new $2M U.S. Department of Energy Advanced Research Projects Agency-Energy grant that is expected to result in a more fuel-efficient and cost-effective hybrid-electric vehicle (HEV). Specifically, the team will work to enhance the fuel-efficiency of the opposed-piston engine (OP Engine) developed by Achates Power. Nissan Motor Company will lend their expertise and perspective as an automaker of hybrid electric vehicles.

HEVs play an important role in minimizing energy consumption in the transportation sector, and projections suggest an increasing number of vehicles sold will be hybrids. Hofmann will develop control algorithms for a commercially available electric motor generator that will turn an OP Engine into a series-hybrid, or range-extender for electric vehicles. Dr. Jason Siegel (principal investigator) and Anna Stefanopoulou, the William Clay Ford Professor of Manufacturing and Director of the Energy Institute, will focus on the engine and its interaction with the motor generator.

"We're going to reconfigure an Achates Power OP Engine by attaching two motor generators directly to the crankshafts of the engine, generating electricity directly from the rotational energy of the engine," said Hofmann. "The electric motor generator we attach to the engine will feed the battery for the range extension delivering consistent, efficient power to the drivetrain."

ALL THINGS ARE PART OF THE INTERNET OF THINGS WITH NEW RFID SYSTEM

Frying pans, pill bottles, yoga mats, coffee cups, and countless other non-electronic objects could be turned into a network of Internet of Things sensors with a new RFID-based technology from Prof. Alanson Sample.

The system, called IDAct, bridges the gap between the estimated 14.2 billion 'smart' electronic devices that are currently part of the Internet of Things and the hundreds of billions of everyday non-smart objects left out of the picture. The researchers say it's a key step toward creating a truly immersive IoT experience.

The technology could also have applications in elder care, where it could be used to unobtrusively monitor medications and daily activities, helping seniors to remain independent longer without the need for expensive and invasive live-in care.

Using RFID readers and battery-free RFID tags that cost only a few cents, IDAct can sense the presence and movement of people in a room and detect the movement of objects with enough detail to determine, for example, whether you've moved a pill bottle or cooked a meal. The tags can be attached to nearly any object in the form of a sticker, and RFID readers that can be integrated into everyday objects like light bulbs.

"Given the ubiquity of these objects, there are significant opportunities for enhancing their sensing capabilities and creating interactive applications around them," said Hanchuan Li, a former graduate researcher in computer science and engineering at the University of Washington and the lead author on the paper.

RFID tags have been used for years to track objects in applications like shipping and theft prevention. The tags absorb just enough electromagnetic energy from the reader's signal to broadcast a simple, unique code. In the past, the reader simply picked up this code to identify whether the object was present or not—on or off, signal or no signal.

IDAct improves on this by providing a more nuanced reading of the signal from the RFID tags. It can detect minute fluctuations in the signal coming back from tags to sense when an object is moved or whether a person is touching it. It can also detect changes in a room's electromagnetic field to infer, for example, when a human is present.

"Every object causes electromagnetic interference in a specific way," Sample said. "We can use that information, along with information from RFID tags, to get a very detailed picture of what's going on in a given space."

These improved signals are then analyzed by a machine learning algorithm run by an on-site computer to infer what's happening in a room. In the testing phase, this processing was done on a laptop, but Sample envisions that eventually, the necessary hardware will be integrated into the RFID reader itself.

The team tested the technology by outfitting a volunteer's apartment with a series of RFID readers and then tagging household objects with RFID tags. They collected 26 hours of data from each room while users were present, and also collected two hours of data from empty rooms as a control.

Faster, Cheaper Gene Sequencing With Hardware Accelerators

Representing the full sequence of DNA for an individual, a genome extends to around three billion characters in length. Only about a million differences exist in that enormous string when you compare one person's genome to another, and it's those differences medical researchers can use to gain valuable insights into genetic disorders and other health conditions. This process of comparing two genomes to analyze their differences is called read alignment, and represents a particularly daunting computational task.

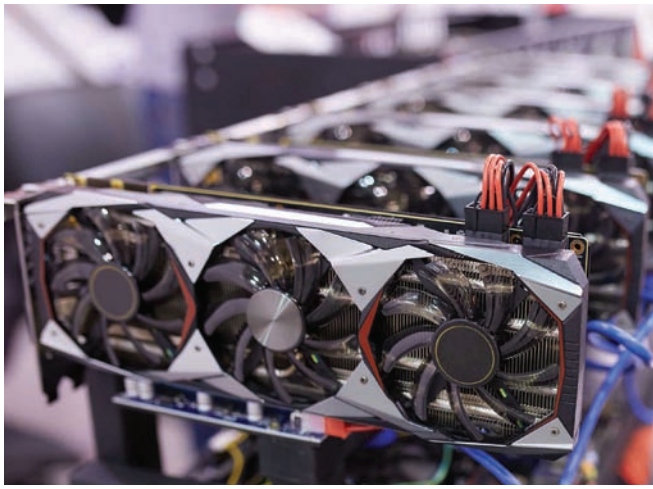
Work by Prof. Reetuparna Das and CSE PhD student Arun Subramaniyan focuses on using hardware accelerators to enable more efficient string matching. These custom processors are designed to perform a specific function as accurately as possible, at the expense of the flexibility that comes with standard CPUs. The researchers saw an opportunity to apply this technology to problems in bioinformatics that could benefit from powerful string matchers – chief among them the problem of processing genomes.

Processing strings as massive as a genome currently takes days. To get that time down to hours and to significantly reduce cost would require 10-100x more efficient computing solutions than those available today.

Read alignment would serve as just one in a longer pipeline of processes to extract valuable data from different genomes. The researchers' goal is to develop an optimized system stack for genomics data analysis that uses hardware accelerators at key points where the computing load is the heaviest.

Developing this field of research could lead to major benefits in healthcare. Genomics marks the transition from population-based diagnosis and treatment of diseases to precision medicine, wherein strategies for disease prevention and drug selection are developed and customized to meet the needs of an individual.

Two Solutions for GPU Efficiency Can Boost AI Performance



Graphics Processing Units (GPUs) have been getting a big workout from new advancements in AI. Now the platform of choice for the machine learning methods collectively called deep learning, GPUs offer significant performance boosts thanks to their parallel computing capabilities.

In dealing with huge datasets, it is also common to distribute deep learning over multiple GPUs in parallel. Achieving cost-effectiveness in these clusters relies on efficiently sharing resources between multiple users.

Prof. Mosharaf Chowdhury and his students are working to make GPUs more effective on both levels, multiplying the number of jobs a cluster can finish in a set amount of time and streamlining methods of sharing resources on the fly. In two papers, the team have described a set of solutions to achieve efficient GPU resource sharing at multiple scales: both within a single GPU (with a system called Salus) and across many GPUs in a cluster (with a system called Tiresias).

Tiresias – led by Juncheng Gu, who is co-advised by Kevin and Nancy O'Connor Professor of Computer Science Kang G. Shin – tackles the fundamental problem of job scheduling, by prioritizing and profiling the size of submitted jobs with GPU-specific constraints in mind. In particular, the team found that far too many GPUs were routinely being given to jobs whose submitters overestimated the number they would actually need.

The team's other system, Salus, is led by Peifeng Yu. It takes a novel approach to GPU scheduling, built on the observation that most deep learning applications never use the full memory or computation capacity of the GPUs they run on. It takes advantage of this inefficiency by instead allowing multiple jobs to overlap on a single GPU. It creates a software layer between researchers and the cluster that acts as a virtual GPU. This faux GPU accepts the job submissions, profiles them and their capacity demands, and "mixes and matches" them onto different shared GPUs.

Together, these systems fit in with Chowdhury's goal of minimizing cost and expense at large data centers with minimal effect on their users.

Your Hard Drive May Be Listening

Hard drives may not exactly have ears, but EECS researchers have demonstrated how a hard drive can be used as a microphone, allowing attackers to listen in to a conversation. Prof. Kevin Fu and his collaborators have found several unsettling ways that sound waves and other sources of interference could be used to commandeer household devices and personal electronics.

The researchers tapped into the feedback system that helps control the position of the read head above the magnetic disk. When the head is buffeted by sound waves, the vibrations are reflected in the voltage signal produced by the drive's position sensors. By reading this signal, Fu and his colleagues were able to make high-quality recordings of people speaking near the drive.

In another test, they showed that music played nearby could be recorded with high enough fidelity that the music recognition app Shazam could successfully identify the song. Malicious software could use this technique to record audio and then secretly upload it to a remote site, thus bugging a room without ever planting a microphone.

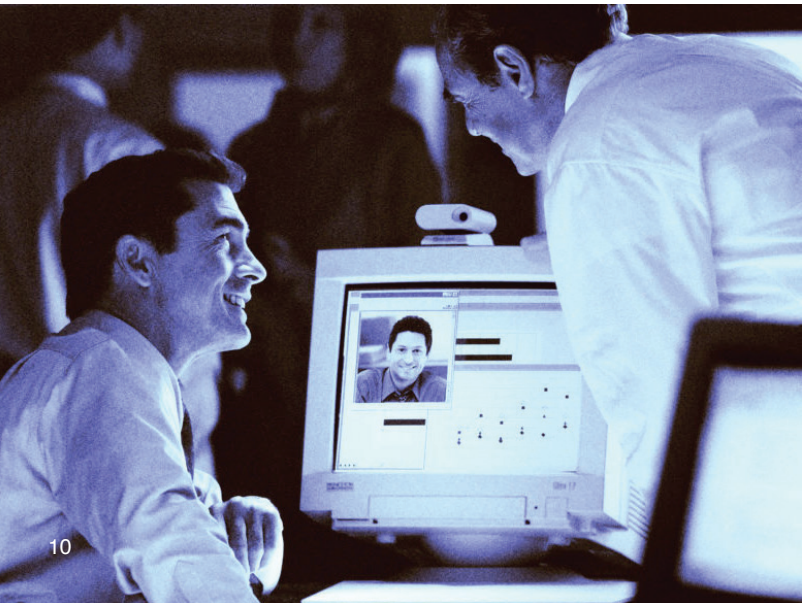
The researchers produced additional mayhem with sound waves, demonstrating that accelerometers in Fitbits, smart phones, and other devices are vulnerable. In one experiment, they showed that certain high-frequency sound waves can cause a Fitbit to add steps without moving. In another test, they used a specific acoustic waveform to force the graph of the voltage output of an accelerometer to spell out the word "WALNUT." This waveform worked even when the sound was surreptitiously embedded in a sound track, so an attacker could, in principle, control your phone's accelerometer by tricking you into watching an online video.

Researchers Spy on Remote Screens — Through a Webcam Mic

Ever wonder what the people on the other end of a videconference are really looking at on their screens? With a little help from machine learning, you might be able to take a peek over their shoulders – all you'll need to do is process the audio picked up by their microphones.

Prof. Daniel Genkin and collaborators investigated a potential new avenue of remote surveillance that they have dubbed "Synesthesia": a side-channel attack that can reveal the contents of a remote screen, providing access to potentially sensitive information based solely on "content-dependent acoustic leakage from LCD screens."

The Synesthesia research leverages "coil whine," the audio emissions from transformers and other electronic components powering a device's LCD display. That audio could be captured and recorded in a number of ways, as demonstrated by the researchers in this case: over a device's embedded microphone or an attached webcam microphone during a Skype, Google Hangouts, or other streaming audio chat; through recordings from a nearby device, such as a Google Home or Amazon Echo; or over a nearby smartphone.



The variations in the audio only really provide reliable data about the average intensity of a particular line of pixels, so it can't directly reveal the contents of a screen. However, by applying supervised machine learning in three different types of attacks, the researchers demonstrated that it was possible to extract a surprising amount of information about what was on the remote screen.

After training, a neural-network-generated classifier was able to reliably identify which of the Alexa top 10 websites was being displayed on a screen based on audio captured over a Google Hangouts call—with 96.5 percent accuracy. While these tests were all done with a single monitor type, the researchers also demonstrated that a "cross screen" attack was also possible—by using a remote connection to display the same image on a remote screen and recording the audio, it was possible to calibrate a baseline for the targeted screen.

The Social Justice Case for Computing Education

As a professor of both EECS and Engineering Education Research (EER) at Michigan, Mark Guzdial is embedded with other computer science faculty to determine how different students think about computing, and just how exactly teaching it is supposed to work.

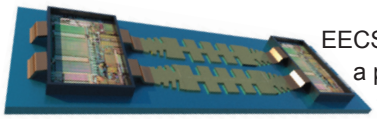
In this role, Guzdial is really one of a kind. The U-M model of embedding tenured faculty whose area of scholarship is EER within traditional engineering departments is a first, and it hasn't been followed by other R-1 institutions. The model is likewise the first to put a significant focus on computing education as an area in its own right, with Guzdial spearheading this effort as the sole computing education researcher in the College.

Guzdial's career in computing education research nearly spans the lifetime of the field itself. Throughout his famous early work, he developed the education technique of media computation to teach coding to new programming students with creative or artistic backgrounds. His ongoing projects explore the ways new coders conceptualize different programming concepts, the best way to introduce these concepts in a way they'll best understand, and the socio-economic factors surrounding the adoption of computer science education around the country.

Ultimately, Guzdial is concerned with the state of computing, the growing role it plays in every layer of people's lives, and the personal duty he feels to expand access to this crucial tool.

"I suggest that programming is a literacy," he writes in a recent two-part exposition on the goals of his field. "It's a way of expressing thought, communicating with others, and testing and exploring new ideas."

Bridging the "Last Centimeter Barrier" in Electronic Communications



EECS researchers are addressing a performance bottleneck that currently exists in the information transfer between electronic chips located a few centimeters apart in a computing system. Led by Prof. Pinaki Mazumder, the researchers' work in making these small but critical connections – dubbed the "last centimeter barrier" – will enable a new generation of electronic systems with ultra high-speed data transfers.

Electronic chips such as processors, GPUs, and memories currently use either metallic wires or optical interconnects to connect internal building blocks and circuit elements. Optical interconnects, though typically high speed, are not energy-efficient for short range communications of 15 cm or less and are, therefore, not suitable for chip-to-chip interconnect. Traditional metal interconnects have bandwidth limitations and can be susceptible to crosstalk at high speed.

Identifying an alternative high-speed interface without these shortcomings has remained an open challenge. Mazumder's team has developed terahertz surface-wave interconnects, a new type of channel that transfers signals in the form of spoof surface plasmon polariton (SSPP), which is a special, surface bound electromagnetic wave in patterned metal using metamaterial engineering. It is immune to crosstalk and can propagate a few centimeters without significant performance loss. SSPP interconnects possess the advantage of CMOS compatibility and their energy-economic quasi-electrical mode can transfer data without requiring excessive energy. Their quasi-optic mode can provide high bandwidth transmission by overcoming conventional limits.

Tyche: A New Permission Model to Defend Against Smart Home Attacks

Is this smart home secure... or vulnerable?

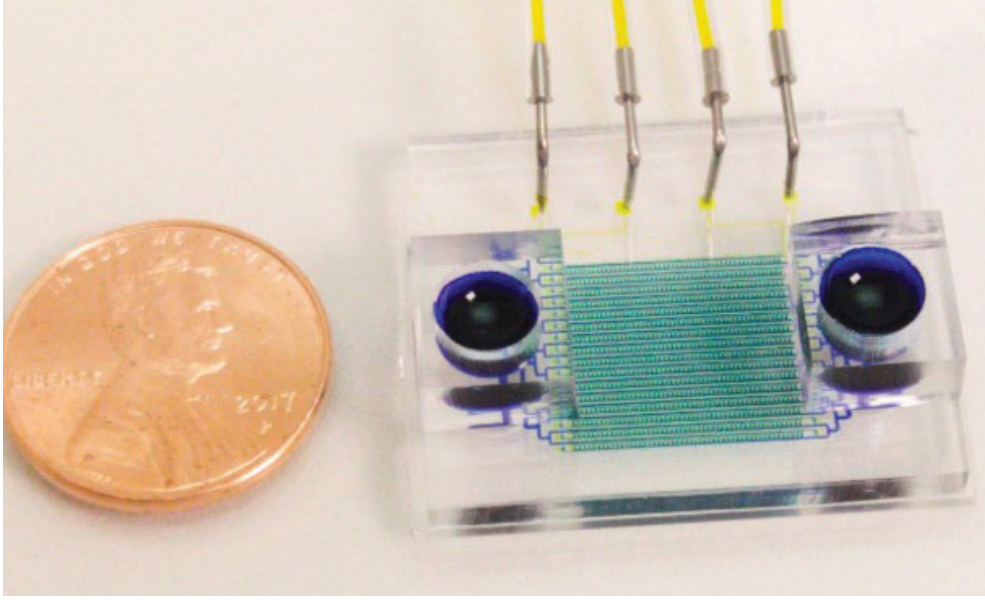
With the use of many integrated smart devices, an app-driven home environment is now a reality. But this young technology faces many new challenges – in particular, how users grant permission to different apps to access device operations. Prompting the user for permission to every individual operation can cause usability issues (too many approval prompts) while grouping permissions by, say, function or device can cause an app to be too powerful and become a future security or privacy risk.

To remedy this, Prof. Atul Prakash, CSE PhD student Kevin Eykholt, and CSE alumni Amir Rahmati and Earlence Fernandes have proposed Tyche, a safer app permissions system for smart homes and the Internet of Things.

Tyche was designed as a secure alternative technique to current app permissions models and introduces the notion of "risk-based permissions." When using risk-based permissions, device operations are grouped by similar risk. Users can grant different apps permissions based on the risk level they trust that app with.

Through this permissions model change, they showed that existing apps better inform users of risks, reduce access to high-risk operations by 60%, and still allow apps to function normally. That is 60% fewer risky operations an attacker could issue in the event of a breach.

Taking on Tumors



This microfluidic chip catches circulating tumor cells (CTCs) and isolates their RNA in a blood sample in order to target tumors and better monitor cancer treatments.

Prof. Euisik Yoon and Max Wicha, the Madeline and Sidney Forbes Professor of Oncology, have collaborated on the creation of a microfluidic chip which can cleanly separate out cancer cells from a blood sample. This process enables comprehensive genetic profiling of the cancer cells, which could help doctors target tumors and monitor treatments more effectively.

It is a dramatic improvement over current approaches because it also encompasses the variation among cancer cells within a single patient. Earlier techniques meant a trade-off between a comprehensive genetic profile of a limited subset of cancer cells, or capturing most of the cancer cells and only being able to look for a few genes.

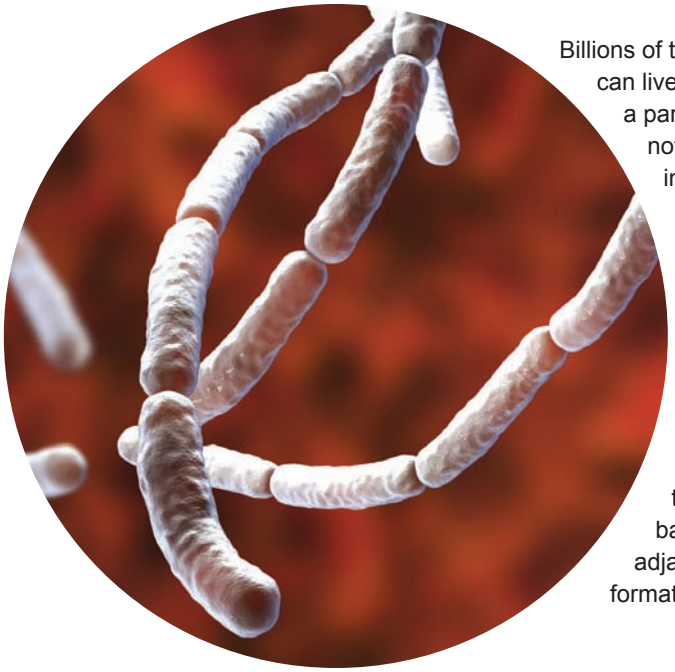
“Our chip allows us to capture pure circulating tumor cells and then extract genetic information without any contamination from red and white blood cells,” said Yoon.

In addition, said Wicha, “It allows you not only to select targeted therapies, but to monitor the effects of these therapies in patients by doing this blood test.”

Many modern cancer drugs work by going after cells with certain genes in play—genes that flag their identities as cancer cells. But these genes aren’t uniformly active in a patient’s cancer cell population and can change over the course of treatment. Repeated biopsies to monitor the tumor are painful and potentially dangerous for the patient. Capturing cancer cells from blood samples offers a non-invasive way to observe whether the cancer is disappearing or whether it is becoming resistant to the treatment.

This work was funded by the National Institutes of Health, the Breast Cancer Research Foundation, the Forbes Institute for Cancer Discovery, and the U-M Coulter Translational Research Partnership Program. The devices were made in the U-M Lurie Nanofabrication Facility.

Understanding Bacterial Communication to Take on Alzheimer’s

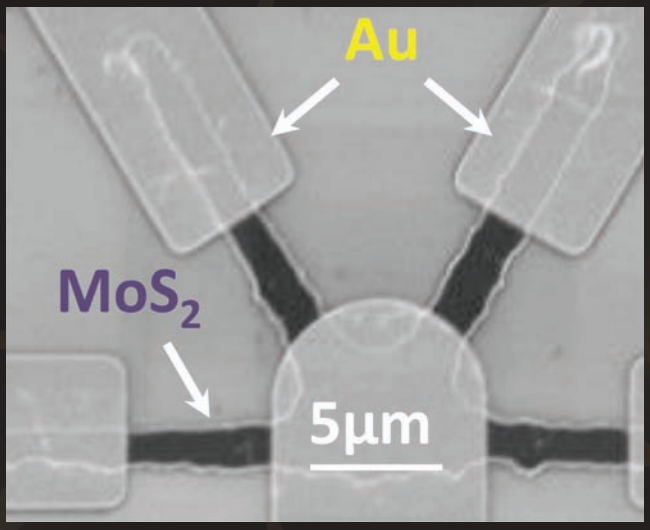


Bacillus subtilis, a species of bacteria found in soil and the gastrointestinal tract of ruminants and humans.

Billions of them live on us. They were the first forms of life on earth, and they can live in even the most extreme climates. They are bacteria, and they are a part of everyday life. Some are harmless, but some are not. While it is not well understood, research suggests there’s a link between bacterial inflammation and Alzheimer’s disease.

A multidisciplinary team is studying Staphylococcus aureus and Bacillus subtilis, two bacterial communities that are associated with Alzheimer’s, and specifically, how they communicate. The project is a collaboration between Prof. Kamal Sarabandi, doctoral student Navid Barani, and researchers from biomedical engineering, chemical engineering, and emergency medicine. It is funded by DARPA under the RadioBio program.

Barani has developed a new multi-physics model to support the theory that bacteria communicate via electromagnetic waves. In this theory, bacteria use built-in antennas to transmit electromagnetic signals to adjacent bacteria. This model could lead to greater understanding about the formation of Alzheimer’s.



An electron microscope image showing the rectangular gold (Au) electrodes representing signalling neurons and the rounded electrode representing the receiving neuron. The material of molybdenum disulfide layered with lithium connects the electrodes, enabling the simulation of cooperative growth among synapses.

Image credit: Xiaojian Zhu, Nanoelectronics Group, University of Michigan.

Toward Brain-like Computing

Prof. Wei Lu and his team have modeled the behaviors of a brain synapse, which is a connection between two neurons in the brain, in computer hardware using memristors. They are exploring, for the first time, how neurons both share and compete for resources, and applying that to computing.

"Neuroscientists have argued that competition and cooperation behaviors among synapses are very important. Our new memristive devices allow us to implement a faithful model of these behaviors in a solid-state system," said Lu.

In a competition scenario, lithium ions were drained away from one side of the device. The side with the lithium ions increased its conductance, emulating the growth, and the conductance of the device with little lithium was stunted.

In a cooperation scenario, they made a memristor network with four devices that can exchange lithium ions, and then siphoned some lithium ions from one device out to the others. In this case, not only could the lithium donor increase its conductance—the other three devices could too, although their signals weren't as strong.

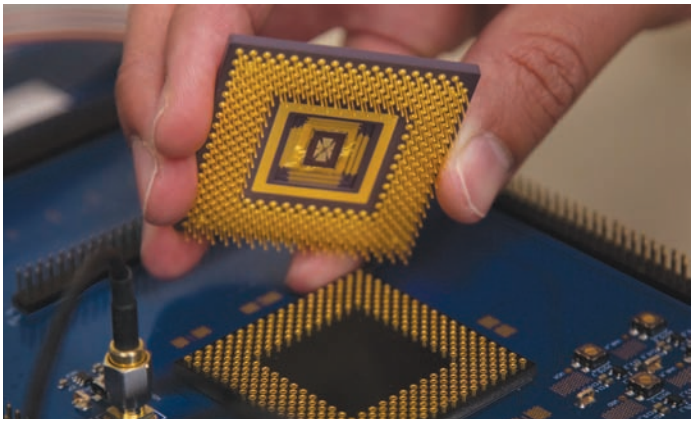
Lu's team is currently building networks of memristors like these to explore their potential for neuromorphic computing, which mimics the circuitry of the brain.

MEMRISTORS are electrical resistors with memory that can store and process data simultaneously. Unlike ordinary bits, which are 1 or 0, memristors can have resistances that are on a continuum.

They could enable new platforms that process a vast number of signals in parallel and are capable of advanced machine learning. Wei Lu's company, Crossbar, Inc., is based on the technology.

First Programmable Memristor Computer Aims to Bring AI Processing Down From the Cloud

Prof. Wei Lu led development of the first programmable memristor computer, in collaboration with Profs. Michael Flynn and Zhengya Zhang. The achievement could lead to the processing of artificial intelligence directly on small, energy-constrained devices such as smartphones and sensors. A smartphone AI processor would mean that voice commands would no longer have to be sent to the cloud for interpretation, speeding up response time. And in medical devices, the ability to run AI algorithms without the cloud would enable better security and privacy.



The memristor array situated on a circuit board.

To build this computer, Zhang and Flynn designed a chip that integrated the memristor array with all the other elements needed to program and run it. Those components included a conventional digital processor and communication channels, as well as digital/analog converters to serve as interpreters between the analog memristor array and the rest of the computer.

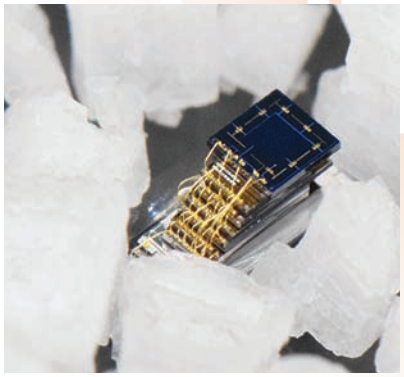
Lu's team then integrated the memristor array directly on the chip at U-M's Lurie Nanofabrication Facility. They also developed software to map machine learning algorithms onto the matrix-like structure of the memristor array. There are plans to commercialize the technology.

Powering the Internet of Tiny Things With GaAs

Prof. Jamie Phillips led the development of a new, tiny solar cell that can perpetually power millimeter-scale computers at high efficiency, even in low-light conditions. The 1.27mm^2 photovoltaic module uses gallium arsenide (GaAs) instead of more conventional silicon to provide the high efficiency required for certain applications, including indoor monitoring and bio-implantable sensors.

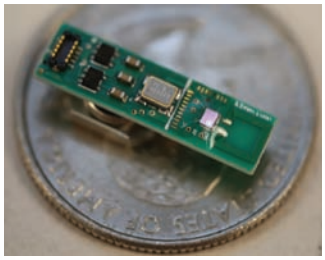
The team that developed the millimeter-scale computer known as the Michigan Micro Mote had been using traditional solar cells made of silicon – the kind that are placed on roofs or sit in solar fields for large-scale energy harvesting. They are inexpensive and easy to manufacture, but are not highly efficient. Looking for a more efficient solar cell, Prof. David Blaauw approached Phillips, who specializes in new optoelectronic materials and devices for photovoltaics.

Phillips and doctoral student Eunseong Moon designed a GaAs photovoltaic module with eight series-connected cells that demonstrated a power conversion efficiency of greater than 26% even at low-flux near-infrared illumination (850 nm at 1 μW/mm^2). The output voltage of the module was greater than 5 V, providing a voltage up-conversion efficiency of more than 90%. The module charged a pair of μAh thin-film lithium-ion batteries under dim light conditions, enabling the perpetual operation of practical millimeter-scale wirelessly interconnected systems.



The Michigan Micro Mote with GaAs solar cell on the top of the stack in a sea of salt crystals.

Communicating With the World's Smallest Computers



A team of researchers led by Prof. David Wentzloff has built the first millimeter-scale device capable of communicating with BLE with a high level of accuracy. It is an achievement that is particularly important for realizing ubiquitous Internet of Things connectivity, and furthers the applications possible with tiny computers such as the Michigan Micro Mote (M^3).

When faculty built the M^3 in 2010, it was the world's first millimeter-scale computer. While the computer has gotten even smaller, the challenge of being able to transmit information on such minute devices has only increased. Antennas are hard to shrink down to this size, and they consume a relatively high amount of energy compared to what the computing device can generate.

As an additional challenge, to make these devices broadly available and adaptable to the latest wireless technology, the researchers wanted the radios to be able to communicate using the brand new protocol known as Bluetooth Low Energy (BLE).

Wentzloff and his team fabricated the first known millimeter-scale BLE transmitter and antenna, and it consumes only 606μW, or 0.6 milliwatts, during transmission thanks in part to their invention called a power oscillator, which combined the oscillator and the antenna in a way that made the amplifier unnecessary.

BLE Bluetooth Low Energy is a wireless personal area network technology that has drawn a lot of attention in the past years due to its low-power architecture, low cost, and growing availability in consumer electronics. Offering a range comparable to regular Bluetooth, it is ideal for Internet of Things and sensor fusion.

Keeping Wireless Sensors in Sync

Wireless sensors need to stay in sync to make sure their data correlates with one another. It is necessary for a wide variety of Internet of Things applications – from body area sensors used for rehabilitation and sport medicine to structural health monitoring, as well as usage monitoring systems for large vehicles such as helicopters and trains.

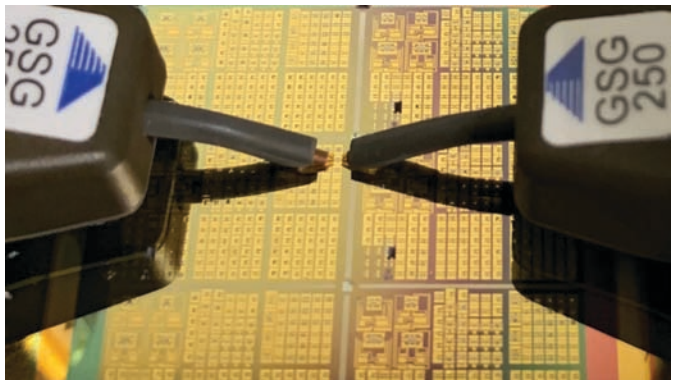
Unfortunately, current methods of time synchronization require a significant amount of power, making them incompatible with small ubiquitous sensing devices. Use of a low-frequency clock can save on power, but unfortunately introduces significant synchronization error.

Working with Prof. Khalil Najafi, doctoral student Farzad Asgarian has developed a way to reduce synchronization error while also reducing the power required. Asgarian developed a frequency scaling method so the processor would dynamically adjust its clock frequency based on the workload. When the processor is only interfacing a low-speed peripheral, it runs at a lower clock speed, which saves power. When it has to complete a lot of tasks, it runs at a higher clock speed.

With this technique, sensors can report measurements using dramatically less power, while still reporting data at a quality found in higher-powered systems. This approach was designed to be compatible with BLE.

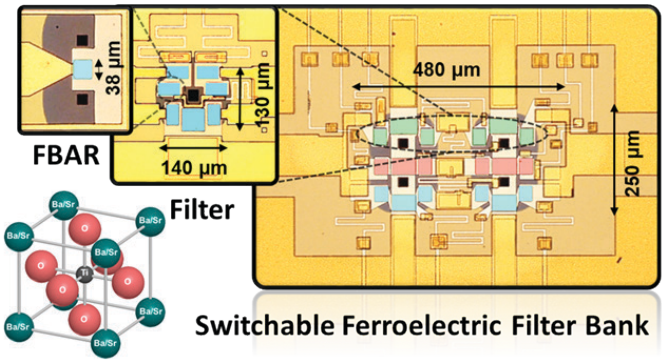
RF Technologies That Enable 5G and Beyond

5G presents an entire new set of challenges to the design of mobile devices. To support many wireless technologies (such as Wi-Fi, Bluetooth, GPS, 3G, 4G, etc.), today's mobile devices already contain a significant number of RF switches and bad-pass filters to set the device operating frequency. 5G will only continue to increase the number of communication frequency bands and accordingly the number of filters and switches, which will increase the circuit size, complexity, and cost.



Prof. Amir Mortazawi and his group are looking to better support 5G by creating a new class of reconfigurable radio frequency (RF) acoustic devices that are only tens of micrometers in size – or the width of a human hair.

Doctoral student Milad Zolfagharloo Koohi pioneered a way to combine switching and filtering functionalities onto a single device and eliminate the need for external switches by employing multifunctional ferroelectric materials. Eliminating the switches has helped to reduce the complexity of RF front-ends and optimize the design of the communication devices.



"We are laying the ground for the upcoming 5G technology and allowing the next generation of communication devices to be much faster and cheaper," said Koohi.

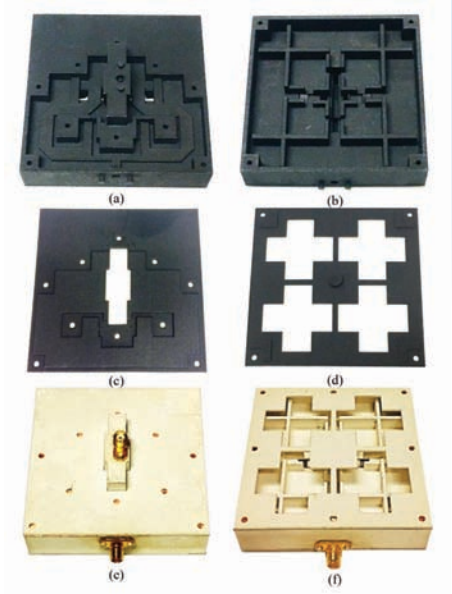
1980's: **1G** gives us analog cell phones

1991: **2G** lets us send digital text messages

1998: **3G** brings the web, GPS, and image sharing to our phones

2008: **4G** gives us broadband with added functionality and speed

2019: **5G** introduces cellular networks suitable for connected vehicles and expanded IoT applications



A New Kind of Antenna to Support 5G

To make 5G a reality, the rate of information that can be transmitted over a given bandwidth in a specific communication system needs to be ultra efficient. However, this is difficult to achieve due to problems that arise with self-interference. To limit self-interference, current transceivers contain transmitter and receiver pairs which operate in half-duplex mode, which unfortunately cuts the amount of information that can get through by half.

Prof. Kamal Sarabandi and his team are working on a full-duplex antenna that can potentially provide services for twice as many users as that of current cellular networks. This antenna system also enables monostatic FMCW radars, which are less expensive and require much less power compared to monostatic pulsed radars and have a wide range of applications, including autonomous vehicles, remote sensing, and biomedical imaging. The antenna could be the key element needed to adapt full-duplex radio repeaters into 5G networks.

A Year of Vulnerability Hunting Uncovers Potential Attacks on Intel Chips, RAM

Over the past year, Prof. Daniel Genkin has worked on a series of projects and research teams that have exposed multiple vulnerabilities on computer components, including two potential attacks on Intel-based processors and another on DRAM chips. All three of these attacks put users' privacy at risk, exploiting new routes to sensitive data.

Foreshadow: This project centered around a finding in the growing field of speculative execution attacks. The exploit affected users who rely on a digital lockbox feature known as Intel Software Guard Extensions, or SGX, as well as those who utilize common cloud-based services. The research team including Genkin identified the SGX security hole, called Foreshadow, in January 2018 and informed Intel. That led Intel to discover its broader potential in the cloud. This second variant, Foreshadow-NG, targets Intel-based virtualization environments that cloud computing providers like Amazon and Microsoft use to create thousands of virtual PCs on a single large server.

Both variants of the vulnerability gain access to the victim machine using what's known as a side channel attack. These attacks infer information about a system's inner workings by observing patterns in seemingly innocuous information—how long it takes the processor to access the machine's memory, for example. This can be used to gain access to the inner workings of the machine.

The attack then confuses the system's processor by exploiting a feature called speculative execution. Used in all modern CPUs, speculative execution speeds processing by enabling the processor to essentially guess what it will be asked to do next and plan accordingly. The attack feeds in false information that leads speculative execution into a series of wrong guesses.

In addition to Genkin, this research was done by Prof. Tom Wenisch and researchers at the Belgian research group imec-DistriNet, Technion Israel Institute of Technology, the University of Adelaide, and Data61.

Fallout: Named Microarchitectural Data Sampling by Intel, this speculative execution attack leaks values from various buffers within an Intel processor. The processor has a number of specialized buffers that it uses for moving data around internally. When the processor reads from main memory, it first checks a certain data cache to see if it already knows the value. If it doesn't, it sends a request to main memory to retrieve the value. That value is placed into a buffer before being written to the cache. Similarly, when writing values to main memory, they're placed temporarily in store buffers.

All three buffers can hold stale data: a line fill buffer will hold data from a previous fetch from main memory while waiting for the new fetch to finish. These attacks perform speculation based on a stale value from one of these buffers. That value can be sensitive and of value to the attacker.

In addition to Genkin, this research was done by CSE PhD student Marina Minkin and researchers from the Graz University of Technology, Worcester Polytechnic Institute, and KU Leuven.

RAMBleed: Led by CSE PhD student Andrew Kwong, researchers uncovered this new data-pilfering side-channel attack that exploits the ever-shrinking dimensions of DRAM chips that store data a computer needs to carry out various tasks. The attack lets unprivileged attackers corrupt or change data stored in vulnerable memory chips and can be used to extract cryptographic keys or other secrets. RAMBleed is similar to previously reported Rowhammer attacks, which work by rapidly accessing—or hammering—physical rows inside vulnerable chips in ways that cause bits in neighboring rows to flip, meaning 1s turn to 0s and vice versa. RAMBleed takes Rowhammer in a new direction. Rather than using bit flips to alter sensitive data, the new technique exploits the hardware bug to extract sensitive data stored in memory regions that are off-limits to attackers.

In addition to Kwong and Genkin, this research was done by researchers from the Graz University of Technology, the University of Adelaide, and Data61.

Online Censorship Detector Aims to Make the Internet a Freer Place

In an advance that could one day provide a comprehensive, publicly available window into worldwide internet censorship, a team of researchers has turned public internet servers across the globe into automated sentries that can monitor and report when access to websites is being blocked.

Censored Planet, a first-of-its-kind system, has begun collecting data on three different types of internet censorship tactics commonly used by governments and others. Project leader Prof. Roya Ensafi says it's a major step forward for online transparency and accountability.

"Currently, censorship researchers must rely on anecdotal information collected from a handful of human volunteers working inside countries where censorship is happening," she said. "One or two people manually visiting websites can only collect a tiny snapshot of information, and they're often in danger of reprisals from the government if they're found out. *Censored Planet*, on the other hand, could have hundreds of electronic vantage points in a given country. It's more ethical, safer, and because it reports consistently, it could provide the first comprehensive picture of how censorship evolves over time."

Ensafi and her team have developed a suite of three tools, each of which plays a different role in monitoring worldwide internet censorship.

- **Augur** scans for TCP/IP blocking, which restricts access to a given web address. The tactic is easy for governments to implement, but because a single IP address can serve hundreds of websites, it tends to cause a great deal of collateral damage, inadvertently blocking hundreds of sites in addition to the one the censor is targeting.
- **Satellite** scans for DNS manipulation, which reroutes a request for a particular web address. This approach can block access to a single site and is widely used by censors around the world.

- **Quack** scans for keyword blocking, when a censor monitors incoming internet traffic for certain keywords, dropping packets that contain those words before they reach their destination. This can be used to block access to information on a given topic across any number of websites.

Running from specially configured computers outside the country being studied, each tool begins by scouring the internet to find publicly available servers that can serve as automated vantage points inside the country of interest. These vantage points are servers that are not owned by individuals, so there is an extremely low chance of them being traced back to any one person.

Once the system has established a network of reflectors—which can be done in a matter of hours—it instructs them to attempt to reach a list of selected web addresses. By analyzing the information that comes back, the tools can determine whether and how those addresses are being blocked.

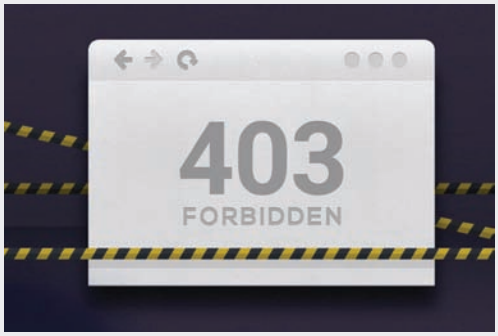
The data collected by the team is publicly available at censoredplanet.org, including a list of the most-blocked websites in monitored countries. They're working with computer science and political science researchers to further refine the tools.

Study Reveals New Data on Region-specific Website Blocking Practices

When a website is blocked to users across an entire country, the popular first assumption is that a government censorship program is at work. While this can certainly be the case, there are other reasons online content might be nationally unavailable. Service operators and publishers sometimes deny access themselves, server-side, to clients from a variety of locations.

A team of researchers led by Prof. Roya Ensafi and PhD student Allison McDonald unearthed new data on this access denial in their paper, "403 Forbidden: A Global View of CDN Geoblocking," to be presented at the *2018 ACM Internet Measurement Conference*.

This paper presents the first wide-scale measurement study of server-side geographic restrictions, or geoblocking, a phenomenon in which websites block access for users in particular countries or regions. Many websites practice geoblocking to comply with international regulations, local legal requirements, or licensing restrictions, as well as to enforce market segmentation or prevent abuse. Some websites even do so simply to reduce unwanted traffic.



Excessive blocking can result in entire national populations being unable to reach valuable sites and content, and the researchers say there is an abundance of evidence that overblocking frequently occurs. The team hopes that quantifying geoblocking will help reduce overblocking practices by highlighting the extent of its impact on users.

Undocumented Immigrants' Privacy at Risk Online, On Phones

When it comes to smartphones, undocumented immigrants struggle to apply necessary caution regarding their privacy and security, according to a study by a team of University of Michigan researchers that included CSE PhD student Allison McDonald.

The study identifies several reasons why online privacy concerns may not be a priority in this group, including the perceived benefits provided by smartphones and social media. For the most part the risks seem vague, like mishandling of information by contacts, while trust in major social media platforms is high.

About half of the study participants make significant adjustments to their daily lives to avoid risks, such as limiting exposure to authorities and sharing important information with fellow immigrants. Yet in the digital space, "even minor decisions, such as the use of phone numbers as account identifiers, can substantially affect the exposure risk of vulnerable communities," according to the study.

The study's results pinpoint possible ways to mitigate the online privacy issue for undocumented immigrants. Existing online digital security resources don't reach this group, either because they don't have the habit of seeking such information online, or because they are not readily accessible in Spanish. Designing more explicit and usable transparency cues and privacy controls could prove helpful, as well, since the owner and others may be at risk if the phone is lost, searched, or confiscated.

Fake News Detector Algorithm Works Better Than a Human

An algorithm-based system that identifies telltale linguistic cues in fake news stories could provide news aggregator and social media sites like *Google News* with a new weapon in the fight against misinformation. Led by Research Scientist Veronica Perez-Rosas and Prof. Rada Mihalcea, the researchers have demonstrated that the system is comparable to and sometimes better than humans at correctly identifying fake news stories.

In a recent study, it successfully found fakes up to 76 percent of the time, compared to a human success rate of 70 percent. In addition, their linguistic analysis approach could be used to identify fake news articles that are too new to be debunked by cross-referencing their facts with other stories.

Mihalcea said an automated solution could be an important tool for sites that are struggling to deal with an onslaught of fake news stories, often created to generate clicks or to manipulate public opinion.

Catching fake stories before they have real consequences can be difficult, as aggregator and social media sites today rely heavily on human editors who often can't keep up with the influx of news. In addition, current debunking techniques often depend on external verification of facts, which can be difficult with the newest stories. Often, by the time a story is proven a fake, the damage has already been done.

Linguistic analysis takes a different approach, analyzing quantifiable attributes like grammatical structure, word choice, punctuation, and complexity. It works faster than humans and it can be used with a variety of different news types.

Amazon's Voice Assistant Will Get Smarter With the Help of U-M Team

Someday, you may ask Amazon's Alexa about the weather in Miami and that query will quickly flourish into an extended conversation with the digital assistant about booking weekend getaways there.

That kind of back-and-forth dialogue with any digital assistant isn't possible today, except in limited settings, like asking for local movie times. But Amazon is working on this very big concept of chatting with a robot with the help of its Alexa Prize Socialbot Grand Challenge, a competition among colleges to build the best social bot.

In 2019, the Alexa Prize unveiled its latest class of colleges for its third year of competition. Among the ten schools selected to compete is a team from U-M co-advised by Prof. Nikola Banovic along with Prof. David Jurgens from the School of Information. The team of 12 graduate and undergraduate Data Science and CSE students will be part of Amazon's broad mission to make its voice assistant smarter, more human-like, and more conversational, so it can become more useful and engaging for its users.

To take part in the Alexa Prize, consumers can simply say, "Alexa, let's chat," to talk to a social bot. The newest group of social bots will become available in September of 2019.

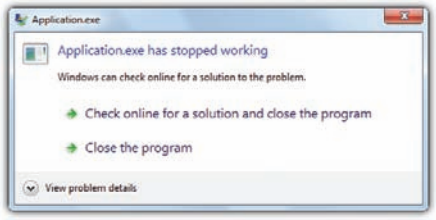
Applications for 2019's competition came in from 15 countries. The selected schools will receive research grants from Amazon, Alexa team support and Alexa-enabled devices to complete their work. Last year's winner received $500,000. Czech Technical University in Prague, another repeat entrant this year, received a second-place prize of $100,000 in 2018.

Making Software Failures a Little Less Catastrophic

There's nothing more frustrating than losing a complicated project to a software crash – everyone's had a video editor shut down without saving or lost a slideshow to a sudden corrupted file. Debugging such software failures is important because of their impact on users, but is notoriously hard in practice because of the limited information that survives once a crash occurs.

Prof. Baris Kasikci and his collaborators are working to take these frustrations down a notch with a new technique called REPT – REverse debugging with Processor Trace. In their paper, "REPT: Reverse Debugging of Failures in Deployed Software," they propose a method to recreate the failing program execution to better diagnose the problem at hand.

REPT is a system that enables what the researchers call "reverse debugging" of software failures in live, deployed systems. Reverse debugging reconstructs the execution history of the software, both in the moments leading up to the crash and thousands of instructions beforehand. It does this with high fidelity, allowing the developers to identify what went wrong with a much higher degree of accuracy than is currently possible.



This data seemed impossible to recover because of the information loss that occurs in a software failure and a system's concurrent execution of other processes. REPT tackles these challenges by constructing a partial execution order based on timestamps logged by hardware and iteratively performing forward and backward execution of each instruction with error correction.

Speeding Up Code With Clever Data Manipulation

Prof. Baris Kasicki and his students have launched two projects aimed at speeding up code. Their first project, called Huron, was aimed at improving program optimization using automated tools. Huron was able to outperform manual human repairs in terms of program performance. With Huron, the group is able to analyze programs to identify their inefficiencies and provide automatic repairs without issues like labor-intensiveness and inaccuracy that typically plague the optimization process.

The goal of their second project, Erie, is to achieve better performance and handling of performance bugs by addressing the key issue of data locality. Existing automated program optimizers stick to manipulating the text part of a program – the actual code. A vital part of how well a program performs is actually in the data part of the program – the information it works with. Erie and Huron are able to restructure the layout of that data after an analysis phase.

"The idea was that we were targeting a particular problem that was hurting locality in programs, which is basically the most important feature in performance," says Kasikci.

In one significant finding, Erie was demonstrated to be compatible with an existing database benchmark system that had been in use for 20 years, applying its automatic fixes based on the output of its evaluation. In that case, Erie provided database repairs that were previously performed exclusively by human programmers.

Helping Popular Websites Better Direct Their Internet Traffic

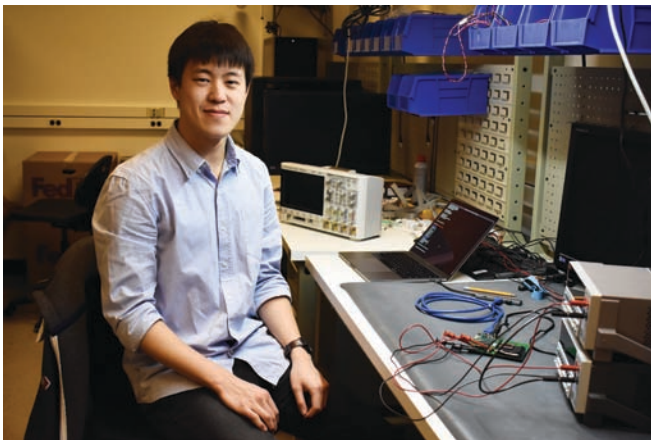
To serve millions of users at once, large websites have to build access points around the world that each connect to tens or hundreds of networks. Even then, peak traffic demands can be hard for the provider to handle while trying to balance two major constraints: the bandwidth limit of any particular route, and the latency it causes for users.

In "Engineering Egress With Edge Fabric: Steering Oceans of Content to the World," Prof. Harsha Madhyastha and collaborators presented a system that large content providers can use to smartly direct traffic over the internet to their users. Facebook uses this system to serve over two billion users across six continents.

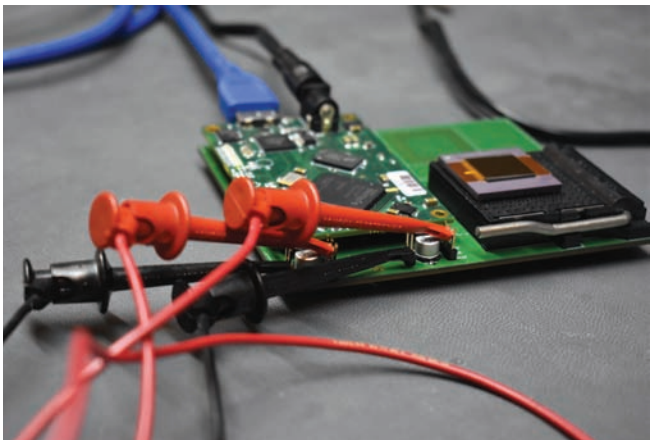
Different routes have different bandwidth limits – the provider can't send every user's traffic down one route, or the provider risks the traffic getting throttled and dropped. Likewise, different routing options result in different latencies to users, some routes being longer or shorter than others. To complicate matters further, these decisions are made mostly blind: the internet's routing protocol doesn't tell the providers anything about these constraints up front. To remedy this, Madhyastha and collaborators designed Edge Fabric, a new system that addresses these issues in real time.

Edge Fabric offers two features to providers – a real-time performance analysis of different routes, effectively outlining the bandwidth and latency of different options, and a way to incorporate this data into routing decisions. The team's goal was to efficiently use the many interconnections available to a company like Facebook without congesting them and degrading users' performance.

Building Better Digital Systems to Support Computer Vision and Machine Learning Applications



Jie-Fang Zhang in the lab.



Chip prototype for sparse deep learning acceleration.

Prof. Zhengya Zhang is building efficient hardware solutions and designing domain-specific architectures for emerging applications. These applications, such as computer vision and machine learning, currently rely on general purpose processors which limits their performance and leads to higher power consumption. New architectures need to be designed to better fit the application.

Doctoral student Jie-Fang Zhang has designed a chip prototype for sparse deep learning acceleration, which could be applied to object detection and image recognition. “I think that the most exciting thing is that I get to experiment with the entire process from designing the architecture to building the prototype to testing the chip,” Zhang said.

Making Machine Vision More Efficient by Basing it on Humans

Prof. Robert Dick and Ekdeep Singh Lubana have developed a more efficient technique for machine vision by modeling it on human vision. They modified a computer camera so it would mimic humans by selectively capturing high-resolution information, rather than trying to capture the entire science in high-res. The data is sent to an application processor, which uses a machine learning algorithm to assess the information. If it needs more information, it tells the camera where to look next to gather more detail. The technique cuts energy consumption by 80% and has almost no impact upon accuracy when used for practical vision applications.

Dick and Lubana tested the technique on license plate recognition, which accounts for 100-billion image captures per year. Future work will expand the technique to other applications, including video.

“It’ll make new things and things that were infeasible before, practical,” Dick said. “Instead of having to change a battery once a week, for example, it’ll work for five weeks.”

Detecting Deepfake Videos

The specific frame of a video chosen by an individual to mark the boundaries of an object makes a huge difference in how well AI software can identify that object through the rest of the video. Being able to automate selection of this frame helps train algorithms to spot doctored clips, as well as improve computer vision in many emerging areas such as driverless cars, drones, surveillance, and home robotics.

“The U.S. government has a real concern about state-sponsored groups manipulating videos and releasing them on social media,” said Brent Griffin, a research scientist working with Prof. Jason Corso on the project. “There are way too many videos for analysts to assess, so we need autonomous systems that can detect whether or not a video is authentic.”

Corso and Griffin developed software called BubbleNets that chooses the best frame for a human to annotate more accurately than currently-available methods. It is able to do this by applying deep learning techniques to the problem.

SLAM-ming Good Hardware for Drone Navigation

One of the best ways for autonomous aerial vehicles, aka drones, to navigate and map their environment is through a process known as simultaneous localization and mapping, or SLAM. SLAM, which is also used extensively in augmented/virtual reality applications, can use a variety of sensing and location techniques such as lidar, GPS, and cameras. Visual SLAM relies solely on cameras, and is the preferred method for drones. However, cameras require extensive processing, which increases the amount of power needed and the overall weight for the battery. That added weight is incompatible with micro aerial vehicles – some of which can be mere centimeters.

The SLAM system onboard a drone in the atrium of the EECS building.

A team of faculty and students, led by Profs. Hun-Seok Kim, David Blaauw, and Dennis Sylvester, have now created the first visual SLAM processor on a single chip that provides highly accurate, low-power, and real-time results. The system also accounted for drift (i.e., small errors that accumulate when mapping a path), resulting in a highly accurate map of the surrounding area.

The researchers were able to do this using convolutional neural networks (CNNs), a deep learning algorithm that has proven to be highly successful in image analysis. Since CNNs require significant resources for computation and memory, they first needed to develop hardware that could support a CNN while flying onboard a drone.

The system was tested on the industrial standard KITTI benchmark, which is often used to compare the vision systems used in autonomous vehicles. It achieved 97.9% accuracy in translation and 99.34% in rotation on KITTI rendering automotive scenes over 1km.

Safe Autonomy

Autonomous Car

In an increasingly automated world, how do we ensure that robots are going to behave safely around us? When that robot is your autonomous car, the stakes become very high.

Profs. Necmiye Ozay and Dmitry Berenson are looking at the tradeoffs an autonomous car's digital brain considers when it's deciding between various routes. While practicing defensive driving and above all, avoiding collisions, what's most important, comfort or efficiency? Even once these constraints and goals are determined, all the possible scenarios can't possibly be pre-programmed into the robotic brain.

"It comes down to being able to understand the constraints in the environment as well as the limits of what your own vehicle can do," said doctoral student Glen Chou, who is working on the project with his advisors, Ozay and Berenson. "So we use data to infer what is unsafe."

The team created a new algorithm to help autonomous cars learn which constraints are most important by observing the demonstrated behavior of humans. Their algorithm is complementary to existing inverse optimal control and inverse reinforcement learning algorithms, and can be easily applied to other autonomous systems, including robots built for search and rescue operations.

Cassie Out in the Cold

While most students were seeking a warm place to study during the polar vortex on January 30, 2019, Cassie decided to take a stroll. She lasted 1 hour and 2 minutes out in bitter cold temperatures of -22C (-8F), more than most can last with not even a thin jacket! On another attempt, she still had 60% battery charge after 90 minutes of walking outdoors in the cold.

"She was amazing," said Cassie's developer, Jessy Grizzle, who is the Elmer G. Gilbert Distinguished University Professor, Jerry W. and Carol L. Levin Professor of Engineering, and Director of Michigan Robotics.

The battery held up better, it turns out, than her body – which cracked when Cassie fell over due to a loose wire.

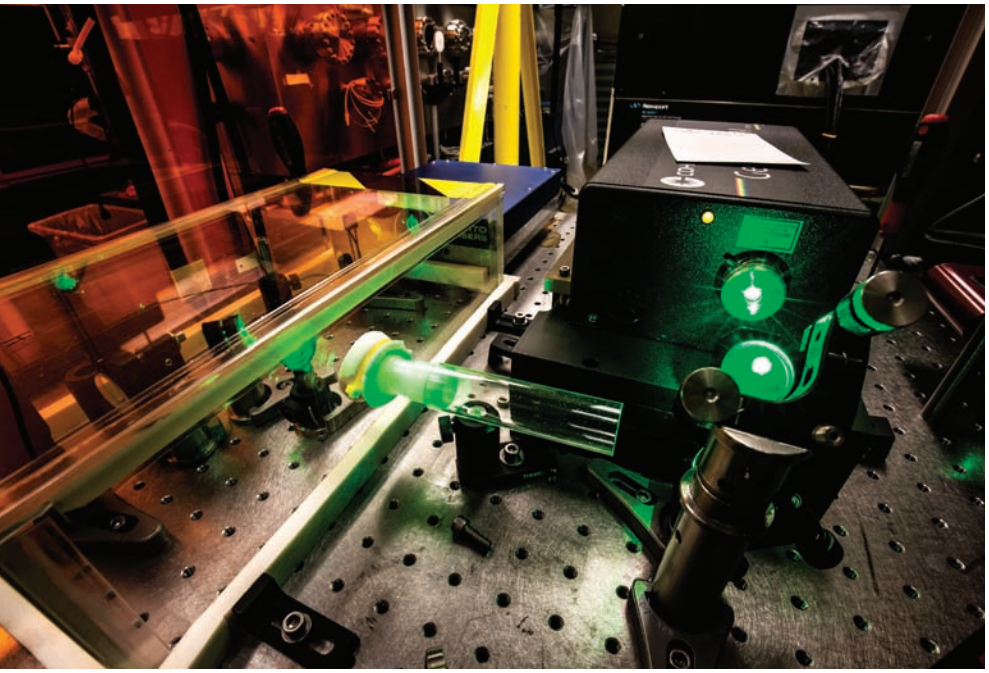
The Robots are Coming, the Robots are Coming

Groundbreaking occurred April 13, 2018 on the new Robotics Building, and things are really shaping up!

The 134,000 sq. ft. building will have a robot playground, an area with mars test soil to test rovers, a 3-story Fly lab, and garage bays for driverless cars.

COME VISIT IN 2020 FOR THE GRAND OPENING!

U-M to Help Drive the American Laser Renaissance



The HERCULES laser holds the Guinness World Records certificate for highest intensity focused laser, producing a beam of 2x1022 W/cm^2.

In response to Europe and Asia surpassing the U.S. in high intensity laser research in the early 2000s, the Department of Energy established LaserNetUS, a $6.8 million initiative to make the U.S. more competitive.

U-M, a pioneer of the field, will receive $1 million through the initiative for providing time on the HERCULES laser, the reigning world champion for laser intensity at 20 sextillion (2×1022) watts per centimeter squared. HERCULES is currently undergoing a power upgrade from 300 trillion watts to 500 trillion or a petawatt. That should double or triple its intensity as well.

HERCULES was built by Gérard Mourou, the A. D. Moore Distinguished University Professor Emeritus and Professor Emeritus of Electrical Engineering and Computer Science. Mourou developed chirped pulse amplification where lasers fire off ultrafast bursts of light shorter than a tenth of a trillionth of a second. For this invention, Mourou was one of three recipients of this year's Nobel Prize in Physics.

High-intensity Lasers for High-impact Solutions

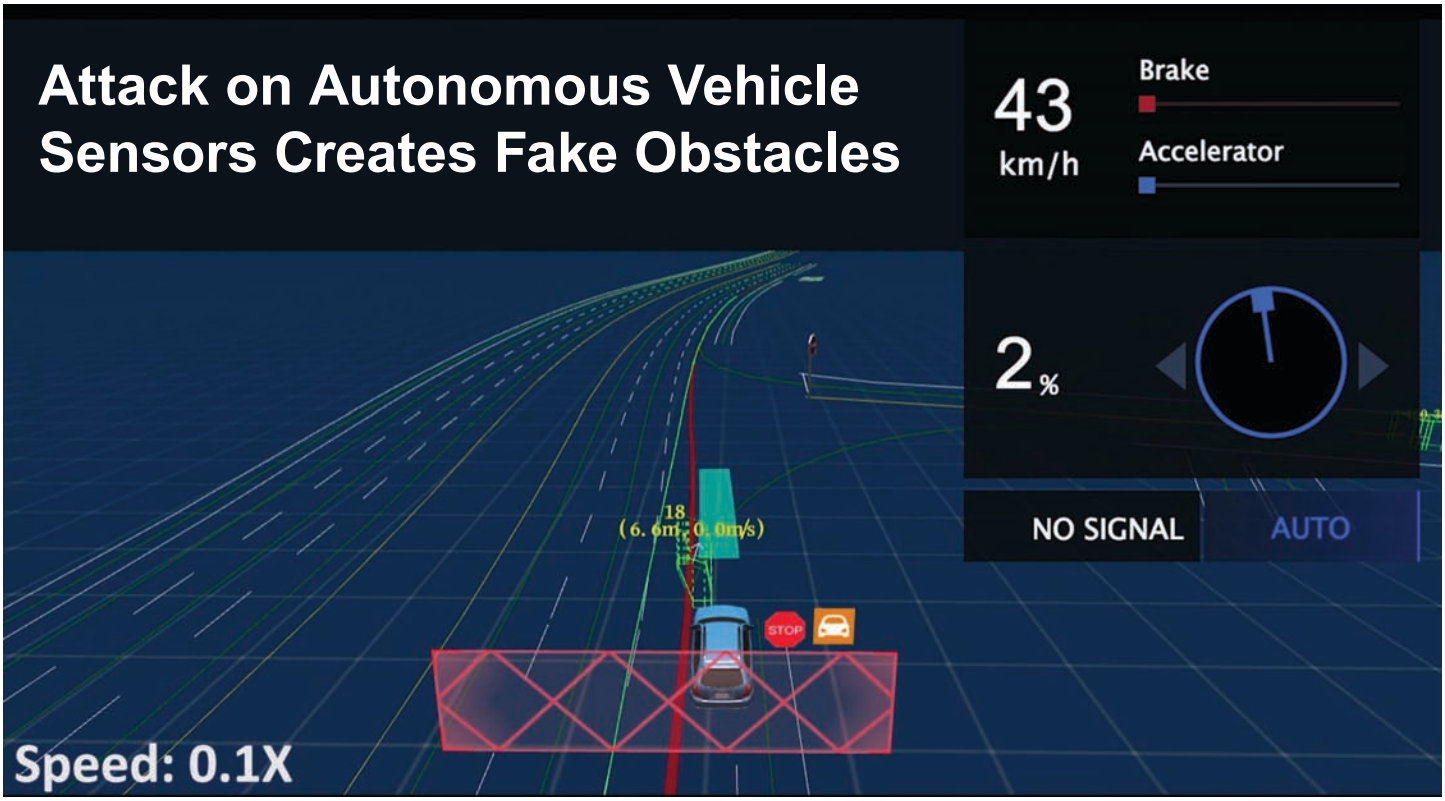
Plasma physics can help us understand solar flares, auroras, and other space phenomena, but it's just as relevant on Earth. Plasma is the fourth state of matter that consists of an ionized gas and contains electrons and ions that respond to electromagnetic fields. Plasma displays, like plasma TVs, use small cells of plasma to illuminate images, but plasma is also found in fluorescent light bulbs, and Fusion reactors use plasma to fuse atoms to release energy.

One of the biggest potential applications of plasma research involves fusion power. Fusion power could change the energy industry completely, providing a reliable, powerful, clean energy source that could power the world for hundreds of millenia.

The interactions among the electrons, ions, and fields in plasma is complex, dynamic, and often difficult to predict. With the help of the T-cubed laser and HERCULES, housed at the Center for Ultrafast Optical Science, and other external facilities such as the OMEGA EP laser at the Laboratory for Laser Energetics, Prof. Louise Willingale works to deepen our understanding of these interactions.

Willingale also works on laser-driven ion acceleration, which is a secondary process in the laser-plasma interaction. One possible application for these ion beams are for hadron therapy, also known as proton therapy or proton radiotherapy. It's a type of particle therapy that uses a beam of protons to irradiate diseased tissue and is a well-established method for treating tumors. Willingale's research could help improve the effectiveness of hadron therapy while making it more cost-effective.

Attack on Autonomous Vehicle Sensors Creates Fake Obstacles



Autonomous vehicles (AVs) currently rely on a number of different sensors to perceive the world around them. In most systems, cameras, RADAR, and LiDAR (or Light Detection and Ranging) work together to build a multi-faceted view of the area directly surrounding the car. The three provide different details that, combined, can safeguard against each other's limitations.

Unfortunately for the designers building these systems, this opens them up to three different sets of vulnerabilities that can be used to sabotage the vehicle mid-drive. Cameras, for example, can fall prey to simple visual obfuscation. Even putting stickers on road signs can completely change their meaning, leading to traffic jams or accidents.

Up to this point, no attacks had been discovered targeting a car's LiDAR system—but a major new finding from researchers at the University of Michigan has demonstrated what that might look like.

A group including the labs of Profs. Z. Morley Mao and Kevin Fu, led by CSE PhD student Yulong Cao, designed and carried out a "spoofing" attack against a LiDAR sensor, effectively tricking the system into perceiving an obstacle in its path that wasn't really there. The attack is able to fool the car's machine learning program meant to serve as a safeguard against these attacks, and can be performed without being seen by passengers on board. The project was the first security study of LiDAR-based perception in an autonomous vehicle.

The team's proposed attack pulls together two components of a standard AV package, its LiDAR sensors and machine learning system. The means to fool the former is somewhat straightforward—LiDAR operates on light, calculating the time it takes light to travel to and from the objects around the sensor. An attacker would simply need to "spoof" an incorrect signal to the sensor by sending light signals toward it. In this case, the team used lasers.

But the machine learning model makes the attack a little more complicated. Operating between an AV's perception system and the signals it gathers from the outside world, the model interprets data from the sensors over time to both provide a detailed complete image and see past anomalies and noise. Because of this, Cao says, the team couldn't simply spoof a random point into the LiDAR's inputs.

"If you just randomly place spoofed points in the LiDAR sensor, it doesn't spoof an obstacle," says Cao. "But if we strategically find a pattern to spoof it can become more powerful and fool the model."

To determine the correct pattern, the team formulated the attack task as an optimization problem, which had been shown to be effective in previous machine learning security studies. They worked experimentally to determine the number and position of data points necessary to create a harmful signal.

The researchers were able to construct two attack scenarios with this method, with a 75% success rate. In the first, an emergency brake attack, they forcec a moving AV to suddenly hit the brakes. And in the second, an AV freezing attack, they forced an AV waiting for a red light to sit "frozen" in the intersection and block traffic.

The paper will be presented at the *ACM Conference on Computer and Communications Security (CCS)* in November, 2019. Authors of the paper are CSE PhD students Yulong Cao, Chaowei Xiao, Benjamin Cyr, and Won Park, CS undergraduate Yimeng Zhou, alum Qi Alfred Chen (now Assistant Professor of CS at the University of California, Irvine), research scientist Sara Rampazzi, and Profs. Kevin Fu and Z. Morley Mao.

New Techniques to Automatically Measure Moods, Detect Disorders

Individuals with mood disorders require regular clinical monitoring to promote long-term health. Yet, current resource-intense and clinic-based methods are costly and inefficient. Clinical observations and evaluations of speech and social interaction patterns are essential to psychiatric evaluation, but few reliable methods to measure, compare, and document changes exist beyond the opinion of the clinical observer and the memory of the patient. These clinical challenges have significantly hampered the development of objective biomarkers.

Prof. Mower Provost and her team propose novel technology, data collection, and computational models that will provide objective assessments of an individual's behavior and social environment based on analyses of comprehensive mobile data that includes ambient speech recordings. This will provide an ecologically valid context in which to study how an individual's behavior and social environment impact his/her wellness.

The result will be new measurement methods to determine how moods and mood episodes shape and are shaped by both the behavior of an individual and daily interactions over time, leading to individualized early warning signs (EWS) for mood disorders.

Making Key Improvements to Healthcare With Machine Learning

Prof. Jenna Wiens uses machine learning to make sense of the immense amount of patient data generated by modern hospitals. This can help alleviate physician shortages, physician burnout, and the prevalence of medical errors.

Machine learning shines when working with massive and complex datasets that electronic health records represent. Medical settings collect an immense amount of data through patient encounters – what medications a patient's on, procedures they've undergone, their location in a hospital, and much more.

Wiens and her students leverage these sources of data by working backwards in collaboration with clinicians to identify a problem for which the data are relevant, and then develop machine-learning and data-mining techniques to try to solve the problem.

The group develops methods for predicting adverse outcomes, particularly during a hospitalization. Recently, they've developed machine-learning models that can predict a patient's risk of developing C. diff infection earlier than existing methods, and can be tailored to accommodate a number of institution-specific factors.

They're also collaborating with clinical partners on developing and improving a model that can predict the onset of Acute Respiratory Distress Syndrome (ARDS), and to better understand the progression of diseases like Alzheimer's, type 1 diabetes, and cystic fibrosis.

Detecting Huntington's Disease With an Algorithm That Analyzes Speech

In an advance that could one day provide new insight into the progression of neurological diseases like Huntington's disease, Alzheimer's, and Parkinson's, researchers have demonstrated the first automated system that uses speech analysis to detect Huntington's disease.

Researchers led by Prof. Emily Mower Provost demonstrated that the system, which analyzes a recording of a pre-selected passage, can effectively detect Huntington's disease 81 percent of the time, as well as track its progression.

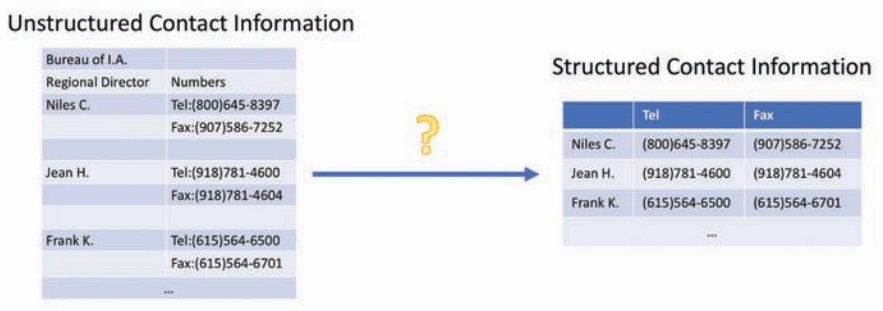
While speech analysis is already used to track the disease's progression, it's an expensive and time-consuming process that requires patients to visit a clinic and record speech for manual analysis. Mower Provost says an automated system could improve patient care and our understanding for how disease symptoms change over time.

The work could power future systems that monitor patients continuously, providing doctors and researchers with far more detailed information than is available today. There currently is no cure for Huntington's disease, which affects approximately 30,000 Americans, with 200,000 more facing a genetic risk of developing the disease.

Ultimately, Mower Provost envisions a smartphone-based system that could continuously record patients' speech and analyze it in real time to provide an ongoing picture of disease progression that could be accessed by both patients and doctors.

The team partnered with clinicians at Michigan Medicine to create their own system designed to transcribe the unique speech patterns of patients with Huntington's disease. They then used the system's output to create a set of measures that can predict the disease. The next step is to refine the system to make it work outside the controlled conditions of the lab, enabling it to recognize disease indicators in spontaneous speech in a variety of settings. Because dysarthria and apraxia are symptoms of other neurological diseases as well, Mower Provost believes that the research may help build better understanding of a variety of diseases in the future.

Tool for Structuring Data Creates Efficiency for Data Scientists



Much of the world's data is messy, unstructured, and therefore unusable. Because of this, data scientists usually have to spend far more time preparing their data than they do analyzing it. Sometimes tidying up datasets can take up 80% of their time.

Transforming this data into a usable state turns out to be labor-intensive and tedious. Traditionally, domain experts handwrite task-specific scripts to transform unstructured data. The requirement for programming hamstrings data users that are capable analysts but have limited coding skills. Even worse, these scripts are tailored to particular data sources and cannot adapt when new sources are acquired.

Enter Foofah, a project developed by CSE graduate students Zhongjun Jin and Michael Anderson, Prof. Michael Cafarella, and Bernard A. Galler Collegiate Professor of EECS HV Jagadish that can help to minimize the effort and required background knowledge needed to clean up data. Their solution uses a technique called Programming-By-Example (PBE), requiring only before and after examples to generate transformation operations automatically.

In most typical data transformation programs, the user is required to select and order different operations to get their data from its messy state to the finished product. This means they have to know what each operation does, and logic their way through the effects each one would have on their dataset.

With a PBE approach, the user just has to know what they want the data to look like when it's finished. They manually clean up one or two examples, feed that to the program, and the operations are selected automatically. Foofah searches the space of possible operations to generate a program that will perform the transformation. In half of the team's experiments, Foofah required only one input-output example to pass the benchmark tests, and only two in another 40%.

Personalized Knowledge Graphs for Faster Search and Digital Assistants

As collective knowledge grows, it becomes challenging for personal devices to sift through all that information and provide the answers users want when they run a search or talk to their digital assistant.

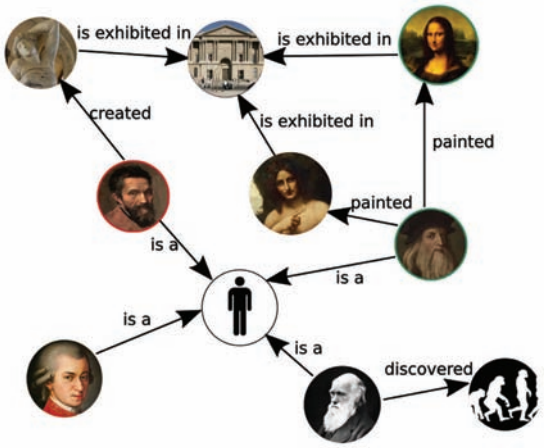
Knowledge is often stored in a structure called a knowledge graph. This collection of nodes and edges stores entities, concepts, and their relationships as a means to navigate large amounts of data. This representation is intuitive for making search queries and inferring knowledge, since these tasks require a way to view the connections between different concepts and things. Unfortunately, knowledge graphs on the order of millions of entities and billions of relationships become harder and harder to efficiently search.

Prof. Danai Koutra has proposed a mobile solution to develop constantly-evolving, personalized knowledge bases that identify information that's most relevant to the user's changing interests. Koutra and her collaborators are working to develop graphs that are customizable and stored locally, and have earned an Amazon Research Award for the project.

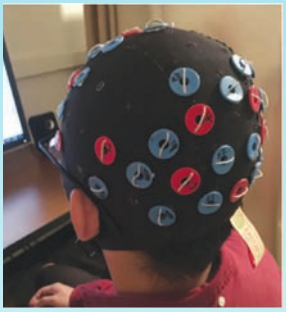
The most relevant current research in knowledge graphs focuses on efficient information retrieval with the use of indices or on knowledge graph summarization to construct concise but comprehensive versions of an original. Neither of these methods are user-driven or flexible to changes in the data, however, which are two features that are important in the real world.

A personalized knowledge graph stored right on the user's device, such as their smartphone, would mean both a huge performance boost and better personalization when interacting with different web services. Searches, voice assistant responses, and other tools would draw from a compact database of the user's interests over time in order to produce more meaningful results faster.

Koutra and her collaborators believe the next frontier of graph summarization lies in personalized and incrementally adaptive techniques. Their future work in this direction will be a step toward efficient information access and knowledge discovery for all users, regardless of location or online connectivity.



"Mind Reading" Study Connects Spatial Problem Solving With Computer Science



The fNIRS cap on the head of a study participant.

What do you think of when you visualize a list? Is your brain behaving the same when you consider adding something to an array and removing a node from a tree? Data structures are some of the key building blocks to any computer science problem, from the introductory to the complex, but coders don't often give much thought to how the "computers" in their heads are handling these tools.

A group of researchers led by Prof. Wes Weimer and CSE grad student Yu Huang set out to do just that, using real-time fMRI readings to look inside coders' brains while they program. This "mind reading" project studied whether manipulating data structures in a program (like balancing a tree) uses the same parts of the brain as spatial reasoning (rotating a map or turning a key in a lock).

To gather this data, the group conducted a human study with 76 participants completing several tasks involving data structures and spatial reasoning, a person's capacity to think about objects in three dimensions.

Psychology research has shown that spatial ability can be a major factor in proficiencies such as mathematics, engineering, and the natural sciences – but despite these relationships, it has rarely been studied within software engineering. In fact, this was the first study focused on the relationship between software engineering tasks and spatial ability that didn't rely on interviews.

Study participants were tasked with mentally manipulating lists, arrays, and trees. Afterwards, they completed mental rotation tasks such as determining if two perspective drawings portrayed the same 3D shapes.

The group then used two medical imaging techniques, fMRI and functional near-infrared spectroscopy (fNIRS), to provide objective measurements of active brain function during each of the activities.

Ultimately, researchers concluded that data structure and spatial operations are related but distinct neural tasks, using 95% of the same regions of the brain but to different degrees. The study also found that harder computer science problems have a bigger effect on neural activity than harder spatial reasoning problems.

A Quicker Eye for Robotics to Help in Our Cluttered, Human Environments

In a step toward home-helper robots that can quickly navigate unpredictable and disordered spaces, a team led by Prof. Chad Jenkins has developed an algorithm that lets machines perceive their environments orders of magnitude faster than similar previous approaches.

"Robot perception is one of the biggest bottlenecks in providing capable assistive robots that can be deployed into people's homes," said Karthik Desingh, a graduate student in computer science and engineering and lead author of a paper on the work published in *Science Robotics*.

Historically, robots operate most effectively in structured environments, behind guard rails or cages to keep humans safe and the robot's workspace clean and orderly. However, a human's environment, at work or home, is typically a jumble of objects in various states: papers across a keyboard, a bag hiding car keys, or an apron hiding half-open cupboards.

The researchers' approach is designed to help robots move from the structured environments of factories and labs into the chaotic and complex domains of humans.

The team's new algorithm, called Pull Message Passing for Nonparametric Belief Propagation (PMPNBP), can compute an accurate understanding of an object's pose – or position and orientation – orders of magnitude faster than previous methods.

The team has demonstrated how their algorithm and a Fetch robot can correctly perceive and use a set of drawers, even when half-covered with a blanket, when a drawer is half-open, or when the robot's arm itself is hiding a full sensor view of the drawers. The team has also demonstrated how the algorithm can scale beyond a simple dresser to an object with multiple complicated joints, in this case through accurately perceiving the pose of the robot's own body and gripper arm.

The paper outlining their work is titled "Efficient Nonparametric Belief Propagation for Pose Estimation and Manipulation of Articulated Objects."

QUANTUM SCIENCE AT MICHIGAN

The world as we see it has been effectively explained by Newtonian physics for about three centuries. Matter invisible to the eye, however, had been operating under its own unique principles. Researchers at Michigan have been studying this atomic and sub-atomic quantum realm for decades, and have now formed a working group to pool their collective wisdom in the area of quantum science. Called the Michigan Quantum Science & Technology Working Group (MQSTWG), their goal is to be a force in the coming age of quantum-generated technology.

"Quantum technology is still in the vacuum-tube [i.e., pre-transistor] era," says MQSTWG co-chair Mackillo Kira, professor of electrical engineering and computer science. "Revolutionary advances in electronic and optoelectronic devices, imaging, information science, and chemical reactions will be enabled in the not-too-distant future."

These advances will have a major impact on next-generation transistors, light sources, and sensing for applications such as quantum information processing and computing, detection of stealth airplanes, mapping of the cosmic microwave background, new materials for next-generation electronic devices, ultra-secure communications, and solar-based fuel, to name a few.

Steve Cundiff, the Harrison M. Randall Collegiate Professor of Physics and co-chair of the MQSTWG, recently participated in the White House Academic Roundtable on Advancing American Leadership in Quantum Information Science as one of approximately 25 invited participants nationwide. According to the official report, "the event marked the re-charter of the National Science and Technology Council's (NSTC) subcommittee on QIS to reflect its role in coordinating the National Quantum Initiative."

The Michigan Quantum Science & Technology Working Group consists of 16 faculty from 7 departments, including Electrical Engineering and Computer Science, Physics, Materials Science and Engineering, Chemistry, Astronomy, Biophysics, and Mathematics.

The working group is representative, but not inclusive, of all the faculty working in quantum science and technology at Michigan. However, not even the Chairs were expecting the 175+ attendees at their first Michigan Quantum Science and Technology Workshop this past April. The Workshop attracted a diverse group ranging from undergraduate students to seasoned researchers from 12 different departments across the university and beyond. Seven companies ranging from Michigan startups to large corporations attended as well.

Six Michigan and eight external speakers offered a glimpse into what's happening in the quantum realm.

"A lot of the basic science has been historically developed in physics," said Cundiff. "But at the same time, it has spanned into electrical engineering, computer science, materials science, chemistry, and this is just to name a few. Our working group spans the entire university, and it was great to see so many people from different disciplines getting the chance to network during the Workshop."

Attendees networking as they get ready for the first Michigan Quantum Science and Technology Workshop.

Center for Microwave Sensor Technology for Low-power Radar, Communication, and Energy Transfer

The University of Michigan and King Abdulaziz City for Science and Technology (KACST), a national center for science and technology based in Saudi Arabia, established a Joint Center of Excellence in Microwave Sensor Technology (CMST) in 2015 to develop low-power radar, communication, and energy transfer technologies.

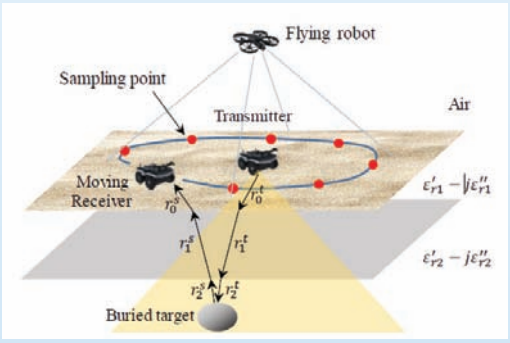
The Center is directed by Prof. Kamal Sarabandi at Michigan and Dr. Waleed Alomar at KACST. Principal investigators include Profs. Ehsan Afshari, Anthony Grbic, Michael Flynn, Dr. Adib Nashashibi, and Prof. Fawwaz Ulaby from Michigan; and Dr. Mohammad Aseeri and Dr. Waleed Alomar from KACST.

The Center is focused on the following four research areas, while also providing numerous workshops and colloquia for educational purposes.

Millimeter-wave Radar for Autonomous Vehicles

Faculty and students are developing technologies and algorithms that will enable the fabrication of compact, low-cost, power-efficient, and all-weather 230 GHz radar sensors for autonomous vehicle applications. The radar will be able to image the entire road scene surrounding a moving vehicle, in real time.

MMW imaging radar placed on top of vehicle.



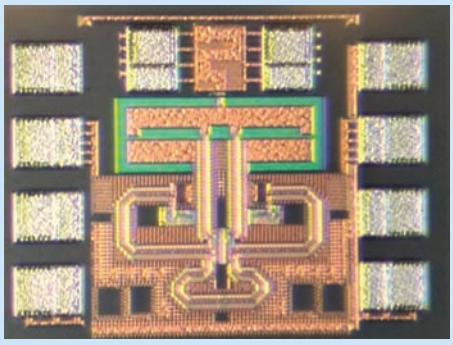
Proposed radar systems for imaging of targets buried in multilayered soil using distributed near ground sensors.

High-Res Subsurface Imaging of Deeply Buried Targets

Researchers are developing a system utilizing distributed near-ground sensors for high resolution and fast 3-D imaging of deeply buried targets that cannot be achieved by current ground penetrating radar (GPR) imaging systems. The expected high-resolution subsurface detection and imaging techniques are desired in areas such as geology, archeology, urban and industrial areas, as well as military and homeland security.

A Fully Integrated Scalable THZ FMCW Imager and Spectrometer

This team of researchers are developing terahertz (THz) integrated circuits for the development of high resolution and spectroscopy with the goal of commercializing the technology. THz frequencies can easily penetrate through many non-metallic materials, and due to their short wavelengths, they are the best candidate for concealed object imaging in airport security checks and industrial quality control for micrometer crack detection.



Compact FMCS fabricated chip.

Some members of wireless power transfer team: Prof. Grbic and engineers Faris AlSolamy and Francis Salas.

Metasurface-based Antenna Technology for Wireless Power Transfer Systems

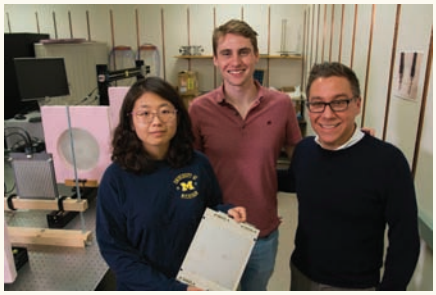
Researchers are developing low-profile, lightweight metasurface-based antennas for the emerging field of wireless power transfer. Specifically, antenna technology based on finely textured surfaces (metasurfaces) with tailored electromagnetic properties will be used to create wireless charging solutions that will be commercialized for eventual public use.

Time-varying Metamaterials for the Future

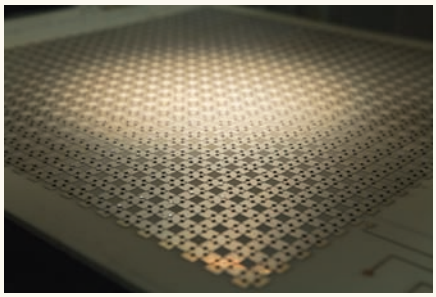
Prof. Anthony Grbic is a key member of a new $7.5M Multidisciplinary University Research Initiative (MURI) to develop more efficient and cost-effective ways to transmit and receive electromagnetic waves. The project could lead to breakthroughs in areas such as next-generation wireless communication, commercial and military radar systems, imaging, and antenna systems.

The goal of the project is to develop magnet-free, non-reciprocal metamaterials that can break the time reversal symmetry of conventional electromagnetic systems.

In this project, Prof. Grbic is using time modulation to develop non-reciprocal metamaterials, which are expected to outperform magnet-based approaches while also being cost-effective, compact, and compatible with electronic integration.

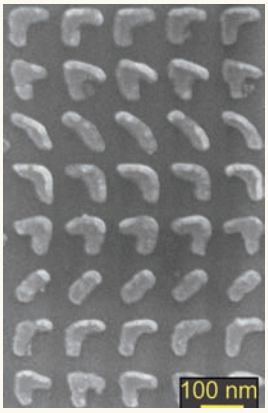


Doctoral students Zhanni Wu and Cody Scarborough with Prof. Anthony Grbic.



An upclose look at a meta-material – a subwavelength-structured, man-made material.

METAMATERIALS Metamaterials are subwavelength-structured, man-made materials that manipulate electromagnetic waves or sound in ways that don't occur in nature.



Metasurface designed by Dr. Carl Pfeiffer composed of 10 million boomerang-shaped antennae.

Synchrotron Radiation With a Metamaterial

Researchers at Michigan and Purdue University developed a metasurface that can bend light inside a crystal to generate synchrotron radiation – in a lab. Synchrotron radiation is usually generated at large-scale facilities, which are typically the size of several football stadiums. However, this new device is only the size of a match head. The researchers used a laser that produces "ultrashort" bursts or pulses of light which last for one trillionth of a second. The array of antennae causes the light pulse to accelerate along a curved trajectory inside the crystal.

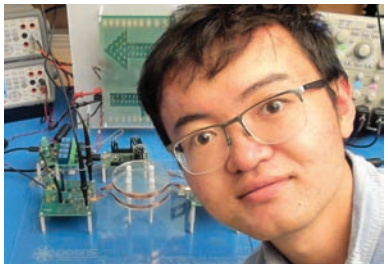
The team hopes to refine their device to produce synchrotron radiation at a single terahertz frequency. Single-frequency terahertz radiation is used to scan items, such as drugs and explosive and toxic gases, hidden in clothing and packaging crates. It can also be used in biomedical imaging to distinguish between cancerous and healthy tissue.

Prof. Anthony Grbic and former doctoral student Carl Pfeiffer developed the metasurface in this project led by Roberto Merlin, Peter A. Franken Collegiate Professor of Physics and professor of EECS. The findings were published in *Science*.

A World Without Cords

Imagine driving your electric vehicle into a parking spot and having it charge without a plug – or recharging implanted medical devices without surgery or other invasive procedures. Imagine protective casings with zero openings, so when you drop your phone in the bathtub, you won't be concerned that you just destroyed it. Imagine a world without cords entirely, where we can easily share and store energy.

This is a world of wireless power transfer (WPT), and PhD student Xin Zan is working with Prof. Al-Thaddeus Avestruz to make it a reality.



Xin Zan in the lab.

Zan's research is focused on high-frequency (3-30 MHz) and very-high-frequency (30-300 MHz) WPT. He has already increased operational frequency from 6.78 MHz to 27.12 MHz over the past year, and he is working on 100 MHz inductive wireless power transfer. Most WPT is focused on lower operational frequency, however, with higher frequency, the systems can have a high power density. It is a challenging task, and proper devices, circuits, control methods, and architectures are needed to maintain both high efficiency and high power during such high-frequency power conversion.

A New Law to Guide the Future of Information Processing

A new "Law of Small Numbers" being worked on collaboratively by researchers at U-M and the University of Cambridge could help power the distributed information processing required for future networks of robots, autonomous cars, sensors, and data centers. This law states that fewer samples of data can provide better results when distributing the task of data interpretation.

This new law will apply only for distributed information processing when information is gathered by a network of sensors, such as an array of security cameras. The information from all cameras needs to be aggregated at some point, but because the cameras' footage will capture similar information, not all the data needs to be sent on to a central point.

"The goal is to exploit the relationship of the information that's collected by the distributed sensors," says Prof. S. Sandeep Pradhan, who leads the U-M team. "That's what we call distributed information processing."

Distributed information processing is becoming more important as industries drown in a deluge of data. By keeping the work of processing raw data on network nodes, instead of centralized processing, distributed networks could keep up to demanding tasks such as monitoring and making decisions based on thousands of measurements in real-time environments for self-driving cars.

"We believe the discovery of this new law of information is big, and will have an impact on the next generation of information processing networks," Pradhan concluded. "We expect new algorithms and protocols to come out of this."

"We believe the discovery of this new law of information is big, and will have an impact on the next generation of information processing networks," said Pradhan.

Less Facebook, More Focus in the Classroom

Cindy Finelli, the director for engineering education research at U-M, is leading a $1.8M multi-institutional NSF project to give professors tools to implement active learning in their classrooms.

"Active learning" is a teaching method that requires students to participate in their own learning, to talk to each other in class, and to purposefully engage with the material. It takes many forms, including polling the students throughout the lecture or having them work together in class to solve a problem about the day's lesson. Not only do students benefit, the professors receive instant feedback on how well students are absorbing the information.

"Some faculty hesitate to use active learning because they think their students will resist by vocally expressing their opposition, being confrontational, or evaluating the class or instructor poorly," Finelli explained. "What we've discovered in our research, however, is that this isn't happening."

Finelli is working with education experts from around the country to provide workshops that help professors adopt active learning techniques into their classrooms.

Prof. Cindy Finelli (front left) in the classroom.

"AIR TRAFFIC CONTROL" for Driverless Cars Could Speed Up Deployment

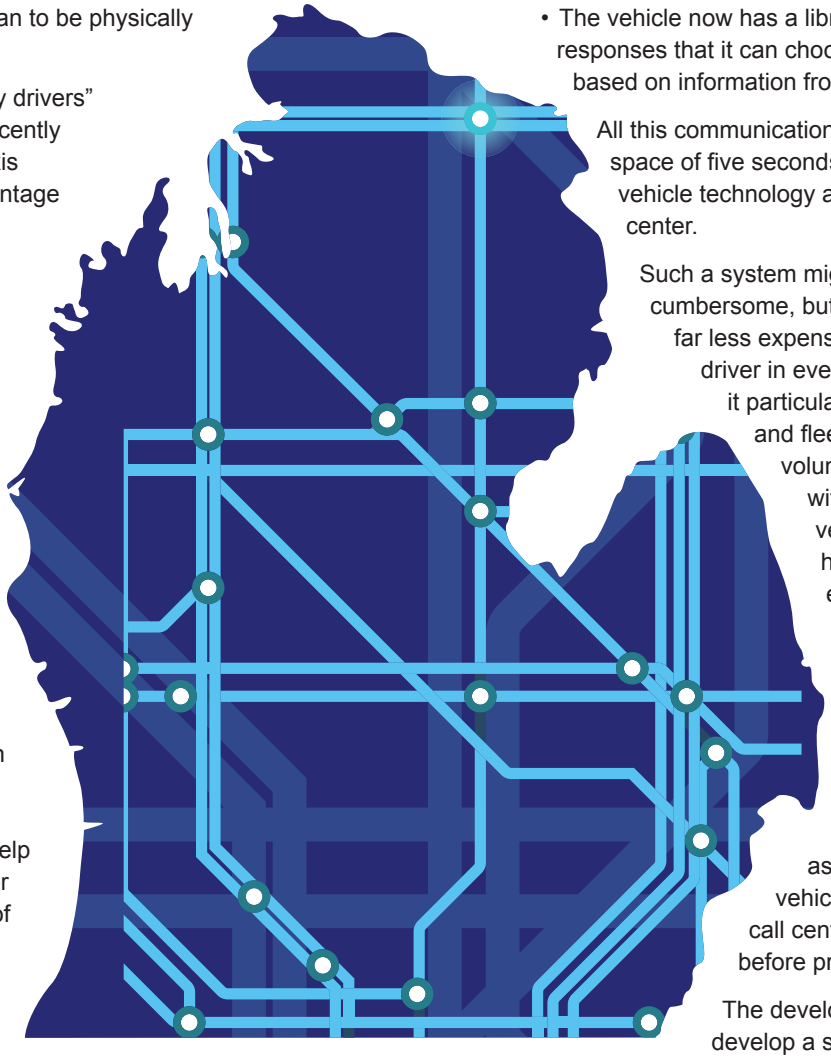
Combining human and artificial intelligence in autonomous vehicles could push driverless cars toward wide-scale adoption. That's the goal of a U.S. Department of Transportation-funded project led by Prof. Walter Lasecki that relies on a technique called "instantaneous crowdsourcing" to provide a cost-effective, real-time remote backup for onboard autonomous systems without the need for a human to be physically in the driver's seat.

The need for human "safety drivers" in vehicles like Waymo's recently introduced autonomous taxis undermines their cost advantage compared to traditional ride sharing services, the researchers say. It also keeps the era of cars as autonomous rolling living rooms tantalizingly out of reach. And most researchers agree that machines won't be able to completely take over driving duties for years or even decades.

Outlined in a recent paper, instantaneous crowdsourcing differs from earlier efforts at remote human backup in that it can provide human responses in just a few milliseconds—potentially fast enough to help dodge a swerving vehicle or maneuver around a piece of roadway debris.

Here's how it would work:

- An onboard algorithm analyzes real-time vehicle data and electronically guesses 10-30 seconds into the future to estimate the likelihood of a "disengagement"—a situation where the car's automated systems need human help.
- If the likelihood exceeds a pre-set threshold, the system contacts a remotely located control center and sends data from the car.
- The control center's system analyzes the car's data, generates several possible scenarios and shows them to several human supervisors in driving simulators.
- The humans respond to the simulations and their responses are sent back to the vehicle.
    - The vehicle now has a library of human-generated responses that it can choose from instantaneously, based on information from on-board sensors.



All this communication would take place within the space of five seconds or less, using connected vehicle technology and a remotely located control center.

Such a system might sound expensive and cumbersome, but the team says it would be far less expensive than having a human driver in every vehicle. This could make it particularly valuable to ride sharing and fleet operators. And the huge volume of miles driven combined with the fact that autonomous vehicles only rarely need human assistance could drive economies of scale that would bring down the cost per vehicle.

The algorithm-based screening at the beginning of the process makes it more useful than earlier attempts at remote human assistance, which required the vehicle to stop, contact a remote call center, and get instructions before proceeding.

The developers are currently working to develop a software platform. They hope to have humans testing the system by the end of the project's first year, with the system capturing data from actual vehicles by the end of the second year.

Helping Drivers Use Smart Cars Smarter

Cars are getting smarter all the time, and most new vehicles come fully equipped with Advanced Driver Assistance Systems (ADAS) like lane keeping and adaptive cruise control. But most drivers don't put these features to use – they're either uncomfortable with the new technology or unsure how it's even supposed to help them.

To bridge the gap between consumer and tech, Profs. Jason Mars, Lingja Tang, CSE graduate students Shih-Chieh Lin, Chang-Hong Hsu, and Yunqi Zhang, and the Ford Motor Company have developed Adasa, a conversational in-vehicle digital assistant that responds to drivers' questions and commands in natural language, helping them get to know the tools their cars have to offer.

Studies have shown that ADAS features have the potential to have a positive impact on the driving experience, with widespread use leading to an estimated 28% reduction in all vehicle crashes. Unfortunately, an estimated 73% of drivers with ADAS-enabled vehicles have not even attempted to use these features. Beyond the uncertainty that comes with a new driving experience, many consumers have difficulty even interfacing with the new tech.

Adasa is the first speech-based approach to solving these problems. Adasa's features are based on the researchers' analysis of over 9,000 conversations between drivers and Ford's customer service division, and includes additional training data generated by crowd workers. Adasa was built using the conversational machine learning platform Lucida, which allows drivers to interact with Adasa in unconstrained natural language in real-time. Drivers can simply ask questions or issue commands after enabling Adasa by pressing a single button on the steering wheel.

The system was integrated into a commercial vehicle and tested with 15 drivers in a real-world driving environment. The study showed that Adasa correctly identified, understood, and responded to over 77% of participants' unconstrained natural language commands about ADAS, which included questions about the current ADAS state and commands to precisely control their features.

Using Drones, a New Software Tool Can Bring LTE Networks Anywhere

LTE networks are ubiquitous today, but require significant infrastructure in a region to operate. This static nature of LTE base stations limits their ability to handle some important mobile network use cases. Providing an additional degree of freedom for base stations – mobility – allows them to break through these limitations.

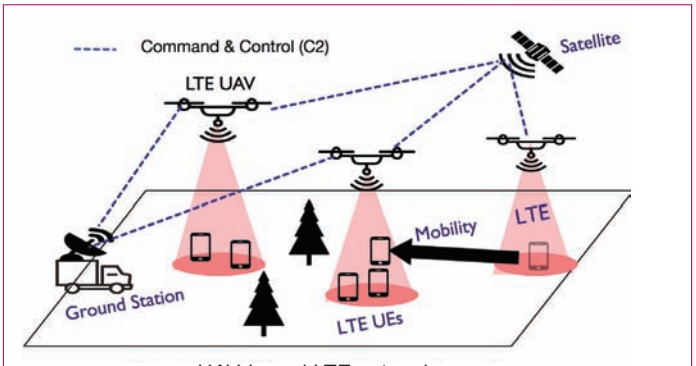
Advances in UAV technology have empowered mobile operators to use them to deploy LTE base stations, which can offer on-demand, adaptive connectivity to hotspot venues and in emergency situations. However, today's tools for sending packets of voice and data information over an LTE network, called evolved packet core (EPC) frameworks, are limited in catering to the challenging, wireless, and mobile environments that UAVs require.

Prof. Z. Morley Mao and alumnus Mehrdad Moradi (PhD CSE 2018) earned a best paper award for their work on SkyCore, a reliable new way to deploy LTE networks using unmanned aerial vehicles (UAVs). The paper, "SkyCore: Moving Core to the Edge for Untethered and Reliable UAV-based LTE networks," demonstrated a way to connect hotspots on drones with commercial networks and smartphones.

This paper proposes an alternate EPC design, called Edge-EPC, designed to address the unique challenges facing the distributed design of UAV environments – specifically, the platform's constrained resources and constant mobility. They implement the new framework with a system called SkyCore.

SkyCore is a complete software refactoring of the EPC framework, focusing on enabling computationally efficient deployment on a UAV. To demonstrate SkyCore's functionality, the researchers built and deployed a fully functional version of the framework on a two-UAV LTE network. This demo was the first of its kind to implement a self-contained Edge-EPC solution able to support a multi-UAV network.

The LTE hotspots provided by SkyCore's UAVs allow for better internet connectivity for users by extending coverage of a standard LTE network. They also act as standalone LTE networks that can connect geographically separated users through two different UAVs, which is especially useful functionality for isolated emergency responders.



UAV-based LTE networks.

The Bats are in Trouble – Can a Video Game Help?

Bat populations across North America could be in trouble, and a video game may help tell you why. The spreading fungal infection, called white nose syndrome, has ecologists concerned and scrambling for a solution, but it's turning out just as difficult to alert the public to the problem.

Austin Yarger, lecturer in CSE, is working on a grant from the U.S. Fish and Wildlife Service to spread the word with a public service video game that simulates the predicament. The strategy simulation, which will enter beta testing in the fall of 2019, takes inspiration from the popular Plague Inc. and has players manage research resources and monitor bat migration to mitigate infection and prevent bat deaths as much as they can.

Among the game's novel design features, Yarger has made the parameters of the game readily editable by the research staff through a shared Google Sheet. The game feeds in data from the sheet dictating key game mechanics, like how easy it is for the fungus to spread and how fast the bats can fly, allowing the researchers to tweak gameplay and add new functions as their research evolves.

"The interesting thing is we're designing a game around a problem that hasn't been solved yet," says Yarger. Faced with this limitation, deciding on a way to "win" turned out to be the most tricky. In the end, the goal is public awareness of the severity of the issue – so winning may not be an option for the time being.

Development of the simulator is primarily done through Arbor Interactive, Yarger's educational games startup in downtown Ann Arbor.

Github Releases New Tools to Report Vulnerabilities Same Day as Study on Security Issues

For most software developers, importing code from third-party libraries is an easy way to add new functionalities to a program without building those features from scratch. But relying on open-source libraries can be risky, as hackers often target security vulnerabilities within them.

Given all this, it's important for users of any library to be able to report potential security issues to the project's owners, so such problems can be fixed before they're exploited. But until recently, many projects on the online repository GitHub lacked a clear way for users to submit security reports.

A research team including Prof. Atul Prakash investigated the prevalence of vulnerable dependencies and the difficulties in reporting them. They analyzed 600 open-source Java projects on GitHub and found that 64 percent used at least one vulnerable library. Moreover, only 19 projects had some kind of reporting process.

To address the lack of a standardized method to report security vulnerabilities in GitHub projects, the team recommended adding a SECURITY.md file which contains contact information and the disclosure policy of a project. The team also suggested support for submitting pull requests or issues visible only to project owners (also called maintainers) as a way to privately disclose potential security problems.

Coincidentally, the team's research was made available online on the same day that GitHub released new security features, which include a security policy and maintainer security advisories. GitHub's security policy involves the same SECURITY.md file recommended by Prakash and the team. Meanwhile, maintainer security advisories, which the company describes as "a private workspace to discuss, fix, and publish security advisories," are similar to the research team's suggested private pull request feature.

TECH TRANSFER

With a focus on startup companies spun-off from technology developed by faculty and students in the EECS Department.

New Platform for Road Scene Understanding

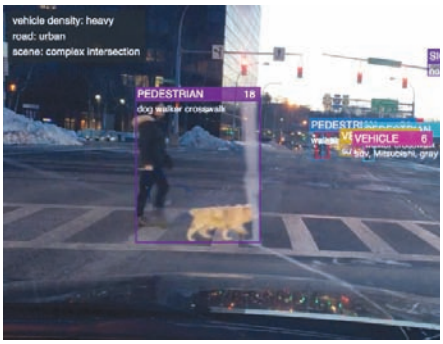
Voxel51, a University of Michigan startup co-founded by Prof. Jason Corso, launched its flagship product—a software platform designed to make it easier, faster, and more affordable to access the untapped potential of video data.

The software is aimed at companies that work with video but struggle to extract the information they need from it. While video is a rich form of data, it is difficult to analyze and search because of its complexity, large file sizes and lack of defined units like words.

Voxel51 has set out to overcome those obstacles with their video analytics platform and open source software libraries that, together, enable state-of-the-art video recognition. It identifies and follows objects and actions in each clip.

Their initial focus, which is particularly relevant to driverless cars, is on video footage from road scenes and for public safety. In both of these applications, cameras are key sensors, but it is time-consuming for humans to process the data so that a computer can analyze it. Faster, automated processing should speed the development of better computer vision.

"This is the first and only publicly available platform for road scene understanding," said co-founder Jason Corso, a professor of electrical and computer engineering. "The auto companies are building them, but in proprietary silos. Ours will be available for anyone to use and try."



This screenshot shows a frame of a video in Scoop, Voxel 51's tool for organizing videos by their content. The vehicles are recognized by type, make, and color. Voxel51's platform performs AI video processing that identifies objects and actions in video.
Image credit: Voxel51

Autonomous Shuttle Fleet Expands Operation

It's been a busy year for autonomous vehicle startup May Mobility, co-founded by CSE Prof. Edwin Olson. Its six-seat electric shuttles are deployed in cities across the Midwest, and with a new round of financing it's undertaken a nationwide expansion. The company now supports routes in Grand Rapids, Michigan; Columbus, Ohio; Providence, Rhode Island; Detroit; and a headquarters in Ann Arbor.

May Mobility develops an autonomous vehicle stack and works with manufacturers to install it in low-speed, compact fleets with safety drivers and digital displays that show route information. Additionally, it offers a fleet operation service that includes cleaning, oversight, and other recurring maintenance tasks. Their electric-powered fleets are deployed for free use by the public, offering shuttle services to airports and around town.

In the spring of 2019, May Mobility announced that it raised $22 million in a series A round. It comes after an $11.5 million seed round in February, and brings the company's total raised to $33.6 million. The company immediately set to work with an expansion to Providence in May and Grand Rapids in July.

Their Providence service offers autonomous shuttle rides across 12 stops that includes the city's Amtrak station. In Grand Rapids, passengers can catch the 22-stop loop around downtown on both sides of the Grand River.

The company has also begun to expand their shuttle design offerings, recently announcing tests of a wheelchair-accessible prototype version. The new shuttles concluded an initial round of gathering feedback from the community in Columbus, Ohio, who would actually be using the shuttle. May Mobility's design includes accommodations for entry and exit, as well as for securing the passenger's wheelchair once it's on board during the course of the trip.

Olson says the company's goal is to gradually roll out an alternative to congested commutes and drives around town.

"Self-driving will save cities from congestion," Olson wrote in a recent Medium post, "not by being deployed in personally-owned vehicles for the affluent, but by fundamentally enabling high levels of service for riders in public transportation systems."

Taking on the Limits of Computing Power

An Ann Arbor-based startup is working to power up genomic analysis in order to revolutionize our understanding of diseases and treatment methods. Founded by Prof. Scott Mahlke and his former students Mehrzad Samadi (PhD CSE 2014) and Ankit Sethia (MSE PhD CSE 2011, 2015), Parabricks Inc. employs proprietary high-performance computing techniques to overcome data-intensive bottlenecks in demanding applications like genome sequencing. Parabricks software integrates seamlessly with state-of-the-art deep learning techniques, Mahlke says, and enables users to focus on extracting insights from data.

The company announced a collaboration with Google Cloud as a Technology Partner in April 2019, launching their accelerated, deep learning based product suite for primary and secondary analysis of sequencing data. Now available on the Google Cloud Platform (GCP) Marketplace, Parabricks reduces the time and cost required to go from raw sequencing data to variants for a whole genome, producing variant calls in less than an hour compared to the standard 30 hours when running the same industry standard pipeline.

“Parabricks software on GPUs enables the unusual combination of scaling speed and throughput of whole genome sequencing by over an order of magnitude,” Mahlke adds. “At the same time, it reduces the computing cost, which is a critical step for precision medicine treatments to become standard for all patients.”

Wei Lu’s Companies Seek to Empower a New World of Human-tech Interfaces

Crossbar was co-founded by Prof. Wei Lu in 2010 to commercialize a radically different approach to non-volatile memory called ReRAM. A unique memory technology that can be integrated inside a system-on-chip or produced as a standalone memory chip, Crossbar ReRAM is playing an important role in enabling a new world of Natural Human-Machine interfaces, autonomous cars, and artificial intelligence.

Recently, Crossbar helped form SCAiLE (SCalable AI for Learning at the Edge), an AI consortium dedicated to delivering an accelerated, power-saving AI platform. The group will combine advanced acceleration hardware, resistive RAM (ReRAM), and optimized neural networks to create ready-made, power-efficient solutions with unsupervised learning and event-recognition capability.

Lu also co-founded MemryX, which developed an in-memory computing system built to significantly outperform today’s CPU/GPU computing architecture for data-intensive tasks. MemryX will receive up to $1 million in investment from U-M’s Michigan Investment in New Technology Startups initiative.

PsiKick, an ultra-low-power wireless sensor company co-founded by Prof. David Wentzloff, has changed its name to **Everactive** and has raised $30M to grow batteryless solutions for industrial Internet of Things. Wireless and batteryless IoT would enable customers to deploy wireless sensors at scale and gain access to new, high-value, data-driven insights.

Movellus Inc., a University of Michigan startup co-founded by U-M alums Mo Faisal and Jeffrey Fredenburg, has secured $6 million in Series A venture funding for a total of $10 million so far. The company provides technology that helps accelerate and optimize semiconductor chip design. Its applications include cloud computing, the Internet of Things, and artificial intelligence.

Conversational AI Company on Rapid Growth Path

Clinc, a leading developer of conversational AI and virtual assistant technologies founded in 2015 by Profs. Jason Mars and Lingjia Tang along with Johann Hauswald (BSE EE 2013, MSE PhD CSE 2015 2017) and CSE research fellow Michael Laurenzano, secured $52M in Series B funding in May of 2019. This is over eight times the size of the company’s $6.3M Series A in February 2017 and is one of the largest single investments in the history of conversational AI. The capital infusion is allowing Clinc to expand its workforce to 140 people the company will soon be opening a new 26,000 square foot headquarters in downtown Ann Arbor. Over 30M people currently have access to Clinc’s technology through partnerships with USAA, Ford, İşbank, Barclays, and others in verticals such as automotive, health care, travel, hospitality, banking, customer service, insurance, and food service.

DEPARTMENT NEWS

SYMPOSIUM CELEBRATES 30 YEARS OF AI AT MICHIGAN

On November 10, 2018, the department's AI Lab celebrated 30 years of leading research with its first annual AI Symposium, *AI for Society*. The event welcomed 250 participants from U-M and around the country for a day of presentations, panel discussions, and poster sessions. Presenters gave a broad picture of AI's applications in the modern world, from finance to health, and from art to data science.

The symposium, open to the public, aimed to bring together participants from both academia and industry with an interest in the foundations or real-life applications of artificial intelligence. Leading the research talks and panel sessions were several faculty from the lab's nineteen core members.

The keynote speaker, alumnus Scott Huffman (MSE PhD CSE '90, '94), spoke about how to build real-world AI products. Huffman is currently VP of Engineering for Google Assistant, Google's conversational AI that interactively helps people find answers on speakers, smart displays, smartphones, and in vehicles.

Symposium activities included 10 technical demos, 13 unconference sessions, a panel, and a poster session. The panel, chaired by Prof. Michael Cafarella, brought together entrepreneurs who are innovating in AI. The unconference sessions addressed subjects including ethics in AI, AI's place in everyday life, bias and data, self-driving cars, and other subjects of contemporary interest.

The poster session featured over 40 displays and demos from Michigan AI's graduate students and their faculty advisors.

The AI Lab was founded in 1988 as an outgrowth of the Computer Vision Research Lab as faculty involved in other aspects of AI joined Michigan. The scope of the lab broadened to encompass areas including cognitive architectures, natural language processing, intelligent tutoring systems, genetic algorithms, logical reasoning, and multi-agent planning.

From its inception, the AI Lab has taken a broad, integrated view of AI. For example, a collaboration between faculty and students involved in vision, planning, and robotics led to a team from Michigan winning the very first AAAI Mobile Robot Competition in 1992.

Thirty years later, the lab has grown to include nearly 20 faculty and research staff, who collaborate often with peers across campus and in industry. Prof. Rada Mihalcea serves as the lab's current director.

2001: A Space Odyssey:

From Science Fiction to Science Fact

Prof. Benjamin Kuipers speaks at the event; to his left is Dean Alec Gallimore and to his right is Prof. Rada Mihalcea.

On September 21, 2018 Michigan Engineering and the University Musical Society co-sponsored a celebration of the 50th anniversary of the classic film, *2001: A Space Odyssey*, which was screened at Rackham Auditorium with live accompaniment by the Detroit Symphony Orchestra. Immediately preceding the screening, three engineering researchers held a panel discussion about artificial intelligence and deep space travel.

In the panel session, Prof. Rada Mihalcea discussed the development of seemingly-sentient conversational AI systems, such as the HAL 9000 system in the movie. She introduced the audience to the concept of the Turing test – which to pass a machine must exhibit intelligent behavior that is indistinguishable from a human – and spoke about the development of conversational systems.

Prof. Benjamin Kuipers highlighted the scene in the movie in which HAL disobeys the command to "Open the pod bay doors," and led a discussion about AI ethics – specifically how ethics knowledge is acquired, represented, and used, and how robots can utilize those approaches to treat people appropriately.

Alec Gallimore, Robert J. Vlasic Dean of Engineering, Arthur F. Thurnau Professor, Richard F. and Eleanor A. Towner Professor of Engineering, and Professor of Aerospace Engineering, rounded out the panel and spoke about how the film had an impact on researchers such as himself and their work in developing advanced propulsion systems for space travel. "It caused me to become the person I am," he said. "I develop the plasma propulsion technology that the movie identifies that would be needed to propel astronauts to Jupiter."

Center Funded to Advance Digital K-12 Curricula

The digital transformation of virtually every industry and organization is well underway. K-12 education is transforming as well, although slowly. However, by 2021 it is expected that every learner in America's schools will have their own computing device. This presents an opportunity for the process of education to be reimagined.

The new Center for Digital Curricula (CDC) has been launched at the University of Michigan to encourage the development of standards for an aligned, vetted, and deeply-digital curricula.

"Teachers do not have the time to develop deeply-digital curricula while teaching and managing classrooms," says Arthur F. Thurnau Professor Elliot Soloway, Co-director of the new center. "And without that new curricula, digital classroom will fall short of their potential."

Deeply-digital curricula integrates media, connectivity, and content in ways that allow students to interact with the content, explore, and collaborate with classmates for a personalized learning experience. As of Fall 2019, the CDC will be using the curricula development tool, the Collabrify Roadmap Platform, to provide free, for Grade 3 science, NGSS-aligned, digital curricula; for Grade 3 math, EngageNY-aligned digital curricula; and for middle schoolers, digital curricula for the new computer literacy. Schools and teachers in Michigan will be piloting these resources this year.

Soloway co-directs the center along with Cathie Norris, Regents Professor, Learning Technologies Department, University of North Texas, Denton, TX.

EECS SUPPORTS OUTREACH
at NSBE Conference

Students, Faculty, Alums, and Robots Came Together at This Year's Record-breaking NSBE Conference

Over 14,000 people and nearly 350 exhibitors descended on Detroit's Cobo Center March 27-31 for the *45th Annual Convention of the National Society of Black Engineers (NSBE)*. It broke the all-time record for both attendance and number of exhibitors, and it featured people from all over the country.

"It's important, because it shows that black engineers exist, and they're doing great things," said Herbert Winful, the Arthur F. Thurnau Professor of ECE, who was a featured panelist at the event. "And for the underrepresented minority engineers and scientists, it's nice to have a community. You can see other people who look like you."

The event centers on workshops for advancing careers in both industry and academia. Jessy Grizzle, the Elmer G. Gilbert Distinguished University Professor, Director of Michigan Robotics, and a professor of ECE, kicked the event off with a presentation and demonstration of Cassie, U-M's bipedal robot. Attendees were given a hands-on experience where they were able to test how the robot balances by pushing it. Afterwards, there was a 30-minute Q and A.

"It was the most engaging Q and A I've ever been a part of," Prof. Grizzle said. "The breadth and the depth of the questions were so impressive. It was super fun."

Prof. Chad Jenkins was a two-time featured panelist at the event, for both the GEM GRAD Lab and Black in AI. At the GRAD Lab Jenkins led a session with Winful and U-M PhD student in Mechanical Engineering Oluwami Dosunmu-Ogunb on how to apply to grad school, covering what the admissions process looked like and processes to be aware of. But most of all, Jenkins was excited to help with recruiting at U-M's exhibition booth.

"NSBE provides unequalled access to talented young scholars of color," Jenkins says. "That was my fourth year going to NSBE, and it's a privilege to see the students who we were once recruiting now recruiting new students."

An entire room was dedicated to the "Wolverine Den," which hosted a U-M alumni reception. The turnout was so great that there was a line out the door. As part of the event, College of Engineering Dean Alec Gallimore held a discussion with EECS alumna Erin Teague, in which the latter discussed her career as Head of Product YouTube Sports and YouTube VR.

"It was really amazing to see all the alumni and what they'd accomplished," said Kwesi Rutledge, a 2nd year ECE PhD student, who also earned his undergraduate degree in EE from U-M. "Definitely blew my expectations out of the water."

Alums emphasized the supportiveness of the U-M community and how it gives them a commonality wherever they go.

"It was really cool to see all the people excited about going into graduate school," Rutledge said. "I think they really appreciated hearing from a current student about what a difference it makes to be at Michigan."

Michigan Delegation is Largest Ever at Tapia

Prof. Chad Jenkins (left) with the students and staff sponsored by CSE to attend the Tapia Conference.

Eight students sponsored by the CSE Division had the opportunity to network and learn at the *2018 Richard Tapia Celebration of Diversity in Computing*, which took place in Orlando, Florida on September 19-22. This was the fourth year that Prof. Chad Jenkins led the U-M Tapia delegation. “It has been great to see CSE establish a significant effort to broaden participation in computing,” he said.

The students sought out career connections with companies and schools from around the country, networked with other participants, met with leaders in industry, explored graduate school opportunities, and attended workshops relevant to their goals. “It was so awesome going there and seeing all these diverse faces,” said undergraduate Akin Coffy. “There’s not a singular demographic, not a majority demographic, everybody feels represented in their own right. Nobody feels left out.”

CSE staff attended as event sponsors and were able to connect with a number of students regarding programs of study in computer science and engineering at Michigan. CSE staff member Yolonda Coleman said that the booth had a frenetic energy as graduate students, faculty, and staff from CSE answered questions posed by enthusiastic attendees. She was especially pleased to reunite with Kyla McMullen (MSE PhD CSE ‘07, ‘12), the first African-American woman to graduate from the CSE doctoral program and now a CS professor at the University of Florida. CSE Graduate Coordinator Ashley Andreae proclaimed, “All in all, it was a huge success!”

This year, CSE was a platinum sponsor for the conference. Additional support for U-M students in attendance came from alumni donors Dr. Peter Lee (BS MS PhD CCS ‘82 ‘82, ‘87) and Susan Lee.

CSE Supports Students at Grace Hopper Conference

Twelve undergraduate and six graduate students in CS and CE joined the nearly 20,000 attendees at the *2018 Grace Hopper Celebration of Women in Computing*, which took place September 26-28, 2018.

The Grace Hopper Celebration is designed to bring the research and career interests of women in computing to the forefront. Like other conferences of this scale, it features research presentations, a massive career fair, resume database service, and on-the-spot interviews with prominent tech companies. But unlike other conferences of this scale, the spotlight is on women.

“At another large conference I went to, I had to actively seek out female presenters that I wanted to go see,” said Zi Yang, a senior who attended for the first time. “Here it was not even something that I had to think about.”

“When you constantly feel like you’re a minority, it is reassuring to attend events like GHC to remind you that you are not alone,” added masters student Lakshmi Ashok. “It shows you that you are no less than any of your peers and that you are equally capable.”

The trip was supported and organized in part by the CSE Division and Girls in Electrical Engineering and Computer Science student group (GEECS), which gave the Michigan attendees the chance to coordinate and plan their trip together.

Twelve undergraduates were supported by CSE to attend the 2018 Grace Hopper Celebration.

“I think it’s definitely important to have conferences and orgs like GEECS and Grace Hopper to bring together people and show a unified front,” said Yang. “It makes you feel better about what you’re doing, and more confident that you can be successful. Look at all these role models ahead of you, and look at all the people you can inspire later, too.”

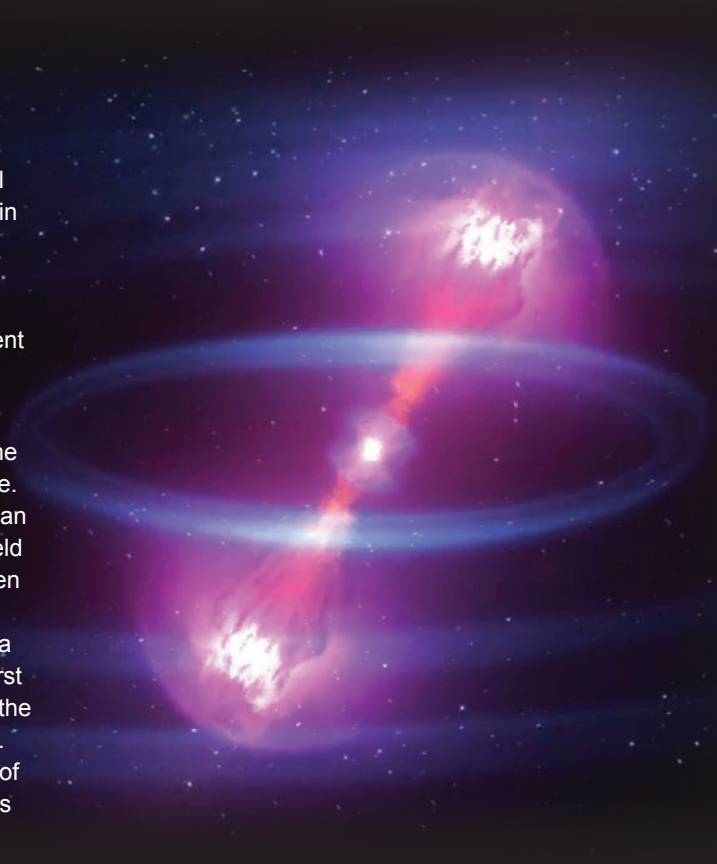
Black Holes and Gravitational Waves

A World-shaking Discovery 100 Years in the Making

The keynote speaker for the inaugural M. Alten Gilleo Distinguished Lecture in Optical Sciences and Optoelectronics was Nergis Mavalvala, the Curtis and Kathleen Marble Professor of Astrophysics and Associate Department Head of Physics at MIT.

Mavalvala spoke about one of the most spectacularly violent events in the cosmos – the formation of a black hole. A black hole is a region of space with an exceptionally powerful gravitational field where not even light can escape. When two black holes orbit each other, the result sends literal shockwaves, known as "gravitational waves," throughout the universe. Mavalvala is a leading figure in the scientific team that announced in early 2016 the first direct detection of gravitational waves from colliding black holes using the Laser Interferometer Gravitational-wave Observatory (LIGO) detectors. The observation of these events – made possible by LIGO's detection of gravitational waves – has ushered in a new era of astrophysics and has helped solve decades-long mysteries about how our universe works.

The Gilleo lectureship was established by Anita Gilleo (BS Lit '44) in honor of her brother, Mathias Alten Gilleo (BSE EE '44) who made significant contributions to optics and solid state physics throughout his career.



This image represents the phenomena that occur when two neutron stars collide, resulting in an explosion of gravitational waves.

Photo credit: NASA's Goddard Space Flight Center/CI Lab.

Friday Night AI Events Engage Local Community

The AI Lab has launched a series of public events that are designed to engage the local Ann Arbor community about issues of AI and society. Called *Friday Night AI,* the first event in the series was held on May 24, 2019 at the Ann Arbor District Library. The topic that evening was "Ethics & Self-driving Cars."

The premier event featured a panel with Profs. Benjamin Kuipers and Edwin Olson as speakers. The two answered questions about the ability of autonomous vehicles to make ethical decisions, if there should be a universal moral code for cars, and where responsibility should lie in the event of an accident.

The second event in the series, "Artificial Intelligence, Personalized Technology, and Mental Health," will take place in September 2019.

ECE Expeditions Showcases Silicon Valley and Michigan

ECE Expeditions takes students on behind-the-scenes tours of a variety of companies from small startups to large multinational corporations. During these trips, students network with engineers, hear from CEO's and VPs, tour campuses and labs, and bond with students from different degree programs and research areas.

This past fall, Expeditions took 25 students to the General Motors Tech Center in Warren, MI, for an insider's look into what an ECE alum might be doing in the high-tech world of modern transportation. GM highlighted a number of ongoing projects including a trailering app, radar and lidar sensor systems on autonomous vehicles, on-star technology, and various antenna technologies.

Over spring break, students journeyed to the heart of Silicon Valley and visited seven companies over the course of two and a half days. Each of these companies featured U-M alums who gave advice and spoke about their current careers.

Students tour a clean room at KLA.

Students get a behind-the-scenes look at Intel.

> **"I thought it was really cool meeting with the U-M alumni there, especially hearing from the CEO, how he came from ECE at U-M. It was really awesome."** — Anthony Wohlfeil (CE junior)

The students visited:

- Agilent Technologies, which provides laboratory equipment for a variety of life science research.
- eLab Ventures, a Venture Capital fund originally started in Michigan.
- Synaptics, a technology company that focuses on improving the human-technology interface. Former President, CEO and ECE alum Rick Bergman welcomed the students.
- KLA, a global semiconductor manufacturing company led by ECE alum Rick Wallace, who spoke to the students.
- NXP Semiconductors, which focuses on developing secure connectivity solutions.
- Matrix Industries, a Michigan start-up that manufactures silicon thermoelectrics.
- Intel, a global semiconductor manufacturing company. ECE alum Navin Shenoy, executive vice president and general manager of the Data Center Group, spoke to the students.

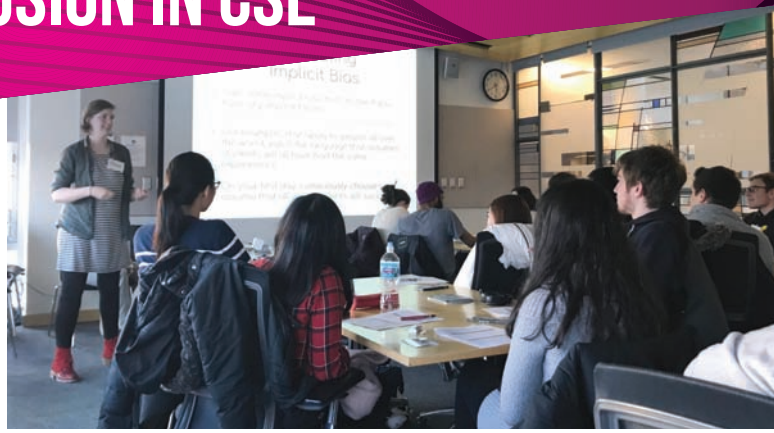
> **"ECE Expeditions was one of the most meaningful things I've done in my college career so far."**
>
> — Carol Zhang (EE sophomore)

ECE Family Fun Night Attracts 500

Over 500 students, alumni, faculty, families, and friends came to ECE Family Fun Night to play, explore, and learn about electrical and computer engineering at Michigan. There were demonstrations from student groups and research labs, games, activities, arts and crafts, washable tattoos, face painting, giveaways, and yummy food. Families got to see the latest technology from student teams such as STARX, which creates powered exoskeletons, MRover, which builds rovers for extraterrestrial environments, and Michigan Baja Racing, which designs, builds, and races off-road vehicles. Many were attracted by the permanent displays showing the World's Smallest Computer, and the Michigan Probes.

The evening culminated with a laser light show featuring dancing silhouettes.

BUILDING A CULTURE OF INCLUSION IN CSE



Training Student Instructors for Inclusive Teaching

The CSE Division has undertaken a new initiative to support a better and more welcoming climate for all students in its introductory courses. The initiative provides specialized training on inclusive teaching to all Graduate Student Instructors (GSIs) and Instructional Assistants (IAs) who teach or provide other instructional support to those courses, emphasizing a number of factors that help instructors interact with students in an inclusive and equitable way.

The initiative, led by Thurnau Prof. Valeria Bertacco, Prof. Westley Weimer, and Dr. Amir Kamil in conjunction with the CSE Diversity Committee, has focused on EECS 183, Eng 101, EECS 203, EECS 280, and EECS 281 – the courses that make up the core curriculum for first- and second-year CS and CE majors.

Over 100 IAs and GSIs participated in one of seven 90-minute workshops on inclusive teaching. The workshops were designed to improve the climate that all students experience in these courses, emphasizing the dangers of implicit biases in instructors and students, educating the participants on stereotype threat and impostor syndrome, and debunking the myth of "essential differences" for students of underrepresented demographics and backgrounds.

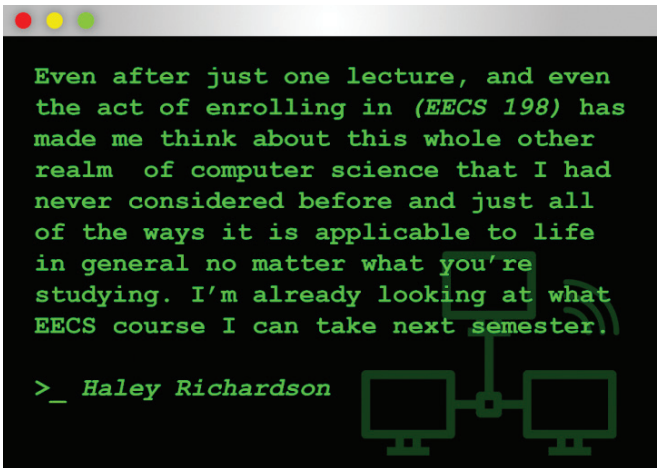
Introductory Course Designed for Women Embarks on First Semester

Discover Computer Science, a new one-credit course led by Prof. Rada Mihalcea and PhD student Laura Burdick, had its first run this year. It focuses on exposing all students – particularly freshmen women – who have not had formal programming experience to the world of computer science. Throughout the semester, students will have the opportunity to learn essential CS concepts, begin to write code, visit local CS companies, and more.

Mihalcea and Burdick developed the course as a way to expand the ideas of the CS KickStart program, which encourages women to enroll and continue in computer science courses at the University. They wanted to expand the goals of the program to more students.

"CS KickStart was successful in introducing women to computer science, so we wanted to think about ways that we could scale that sort of initiative and reach a larger audience," Burdick said.

LSA senior Haley Richardson did not consider herself a programmer before receiving an email about the new class. Richardson described how she appreciated being in an environment designed for women, especially given the race and gender disparities in CS.

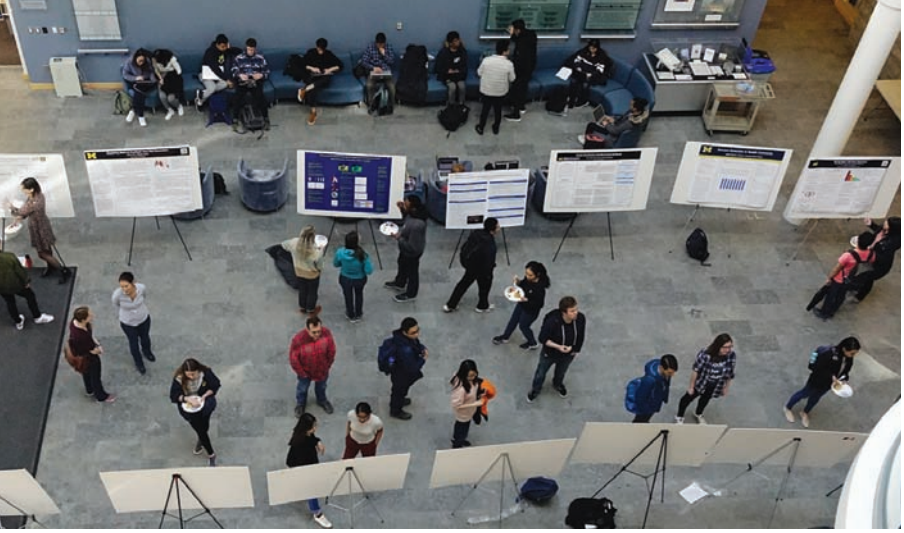


"I like the idea of having a class that is geared towards people who are sort of underrepresented and inexperienced in this field and giving them the chance to dip their feet it," Richardson said.

Mihalcea also pointed out the lack of women in the CS field and expressed the EECS Department's desire to continue programs working to combat the issue.

LSA freshman Monica Iyer is another student in EECS 198 who had little prior programming experience, but wanted to explore the realm of CS. Iyer has enjoyed the course so far and echoed Richardson's sentiment about its engaging and collaborative environment.

"It's all girls so far, and a lot of them also haven't really tried computer science — or at least people I've talked to," Iyer said. "Everyone seemed really excited and willing to help."



Introducing Women to CS Research

An event hosted by CSE on April 15, 2019 gave undergraduates a taste of what it's like to do research for a living. The poster session and panel on "Research as a Career" invited students to find out what it means to do research full time, to learn the ins and outs of a researcher's life, and to ask questions of research scientists, engineers, PhD students, and faculty.

The event's poster session was the culmination of a year-long program led by Prof. Rada Mihalcea and CSE PhD students Laura Burdick, Laura Biester, and Allison Lahnala to engage undergraduate students on the topic of diversity in research. The program enrolled 45 students, who were mentored by 16 faculty.

Throughout the semester, each student participated in 35 hours of research with their mentor on a task they worked together to define. Additionally, the program included workshop sessions, research seminars, and a panel on research careers.

The panel session included perspectives from a variety of researchers from U-M and industry. The panelists were Uriah Israel (graduate student in Applied Physics), Research Scientist Verónica Pérez-Rosas, Prof. Danai Koutra, Rini Sherony (Toyota), and Beaumont Vance (TD Ameritrade).

Through the panel session and mentoring relationships established in the program, the organizers hoped to equip students with the knowledge and skills they need to successfully apply to a graduate program, as well as the confidence that they can succeed in a research environment.

The project, "Building a Diverse Research Community: Introducing Women to Computer Science Research," earned the maximum award of $35,000 from Google's exploreCSR: Google Grant Pilot Program for Undergraduate Computer Science Research Focused Workshops for Women.

Kickstarting an Interest in CS for First-year Women

The third annual *CS KickStart* gave 22 incoming women with an interest in CS a hands-on look at the skills and careers offered in the world of computing. C*S KickStart* is a free week-long summer program for incoming first-year students that aims to improve the enrollment and persistence of women in CS.

The 2018 student organizers were undergraduates Sage Renstrom-Richards, Meghana Somsaale, Rebecca Andrews, Jenny Sokol, and Audrey Ladd. Through the program, they strove to strengthen the community of women in CS and expose them to the diversity of the tech industry. During the week, the program organizers facilitated conversations about diversity, taught participants how to program, provided them with campus resources, and showed them the applications of computer science in academia and industry.

A major focus in 2018 was a series of labs and workshops that taught students a number of basic CS skills. This included seven Python labs that covered loops, functions, lists, and other coding basics, an introductory C++ lab, an Arduino lab, and a computer architecture lab that gave attendees the chance to tear apart old computers and find parts.

Faculty presented highlights from their research; this included Kentaro Toyama, W.K. Kellogg Associate Professor of Community Information at the School of Information; John Laird, the John L. Tishman Professor of Engineering; Prof. Reetuparna Das; and the work of Prof. Roya Ensafi, presented by her PhD student Reethika Ramesh.

Throughout the week's events, organizers put an emphasis on building community among the participants, said Andrews.

"When they begin to face the frustrations of debugging or the doubt that comes from imposter syndrome," she said, "we want the participants to still have a group of people that support them, understand their struggles, and encourage them to stick with it."

Andrews considers herself one of *KickStart's* success stories, and has now helped organize the event twice.

"I participated in *CS KickStart* before my first year began, and I don't think I'd be studying computer science without it," Andrews said. "It gave me confidence going into my freshman year that I could pursue CS and be successful, despite not having any coding experience."

ECE Celebrates World-wide Customs and Inclusivity

Lunar New Year

The Lunar New Year (Chinese New Year) is a widely celebrated occasion in Chinese culture. ECE's celebration includes Chinese music, cuisine, and calligraphy, and was held this year on February 6, 2019, a day after the official holiday.

Photos by: Marcin Szczepanski, CoE Visual Communications Director.

Nowruz

Nowruz is part of the Persian New Year festival and is held on the first day of spring and the first day of the solar calendar. It's origin dates back to more than 3,500 years ago and is about spending time with family, friends, and neighbors. ECE brings together students, faculty, and staff, for the holiday and provides traditional music, food, and decoration.

Food was provided by the Caspian Mediterranean Grill.

The holiday includes the Haft-Seen, a tabletop arrangement of seven symbolic items.

Iftar

Iftar is the evening meal when Muslims end their daily Ramadan fast at sunset. Ramadan is the 9th month of the Islamic calendar and is celebrated by Muslims worldwide. For Iftar, ECE hosts a halal dinner open to everyone.

ECE Community Takes a Stand Against Bullying

ECE students, faculty, and staff got together on Spirit Day to show their support for LGBTQ+ individuals and learn how to be better allies. Spirit Day, which occurred on October 18, is a world-wide anti-bullying campaign designed to raise awareness about the challenges and issues faced by members of the LGBTQ+ community. Members of the ECE community shared stories, exchanged hopes, and pledged ways to better support one another.

Outreach Camps

Electrify Tech Camp Goes to Detroit

This summer, Electrical and Computer Engineering added a fourth week to the highly popular Electrify Tech Camps. Traditionally held on campus, Electrify gives high school students hands-on experience in electrical and computer engineering and includes special activities designed to introduce the camper to Engineering at Michigan. This marks the first year Electrify traveled to the Michigan Engineering Zone (MEZ) in downtown Detroit. The MEZ, sponsored by the College of Engineering in collaboration with Detroit Public Schools, offers space to a variety of programs designed to expand Detroit-area students' exposure to the world of science, technology, engineering, and mathematics.

"One of our program's goals is to make Electrify accessible to as many students as possible so they can learn more about electrical and computer engineering," said John Feldkamp, ECE's Student Recruiter who managed the program. "By hosting a program at the Michigan Engineering Zone in Detroit, we were able to bring the Electrify experience to a new location and help students and families connect with Michigan ECE."

"Engineering has always been something I've wanted to do," said Gisele, a camper at the Electrify program in Detroit who's going into her senior year. "I've always loved math and science and putting things together to figure out problems, so my mom was searching around for an engineering camp for me to do this summer, and she came across this one. It was right down the street from our house, so she was like, 'Perfect!'"

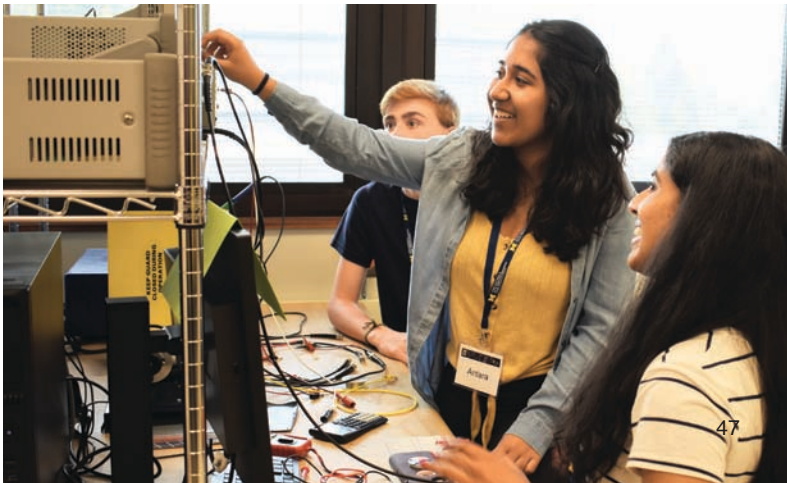
Electrify Tech Camp

Due to the generosity of community members and corporate partners, scholarships were available for students to attend the tech camps. Members of Detroit Labs came together to fully sponsor five students attending Sense It Detroit.

"The most valuable thing about this experience for me was being allowed to do both the programming and the hardware," said Andrew, a camper at Electrify Detroit who's going into his junior year. "It really allowed me to be creative and find my own solutions."

Three different camps were offered this year. In Power Up, students learned how systems are powered, the challenges of different sources of energy, and the basics of circuit design. In Sense It, offered in Ann Arbor and Detroit, students learned the fundamentals behind wireless sensors and how they are being used in modern technology. And in Nano-Size It, students explored the world of "small" and even put on bunny suits to enter the world-class Lurie Nanofabrication Facility.

"It was a really fascinating experience," said Mahbuba, a camper at Electrify Detroit who's going into her junior year. "I'm going to use the knowledge that I gained to go back to my school and teach my peers how to actually do these things."



Outreach Camps

A Start in AI

A group of 9th and 10th grade students had the opportunity to learn about artificial intelligence and to experience college life at the AI4All residential camp, which took place July 9-20, 2019 on U-M North Campus.

The program was sponsored and funded by AI4ALL and CSE. AI4ALL is a national nonprofit focused on increasing diversity and inclusion in artificial intelligence. They create pipelines for underrepresented talent through education and mentorship programs around the U.S. and Canada, and work in partnership with higher ed institutions and corporations to reach underserved communities.

Directed by Prof. David Fouhey, the two-week Michigan camp featured programming classes, lab tours, panels and speakers, and field trips to GM and Michigan Stadium. The campers experienced dorm life and developed projects over the course of the camp that they ultimately demoed at an expo on the final day, after which they were inducted into the AI4ALL Alumni Community.

AURA Program Brings Ethiopian Students to Michigan

Ten students from the Addis Ababa Institute of Technology (AAiT) in Ethiopia came to Ann Arbor for twelve weeks during the summer to engage in research work with a faculty member as a part of the new African Undergraduate Research Adventure (AURA) program. The students worked on projects in software engineering, electrical engineering, and mechanical engineering.

“The University has had a long-standing commitment to global engagement,” says Arthur F. Thurnau Professor Valeria Bertacco, one of the program’s organizers. “The idea of AURA is to bring students from AAiT in Ethiopia to Ann Arbor for the summer to be embedded in a research experience.”

She adds that the ultimate goal of AURA is “to create collaborations between U-M faculty and AAiT students, which could lead to a range of research collaborations, including applications to our doctoral and master’s programs.”

The students who participated in AURA described the program as quite positive and even life-changing. “This program has shown me that I don’t really need to sacrifice my passion and try to fit into an industry job,” said Binyam Paulos Chamiso. “But it has shown me that I can do research in areas I am interested in.”

AAiT undergraduates are required to develop a thesis to complete their degree – their entire fifth year is dedicated to it. The AURA program is a key opportunity for them to bootstrap this thesis work.

AURA was organized by Prof. Bertacco, Prof. Todd Austin, and Fitsum Assamnew Andargie of AAiT.

NEW COURSES

As technology changes and advances, so does our coursework. In addition to constant upgrades to core courses, the following new courses have been introduced over the past year.

ACCELERATED AI AND HEALTH
(EECS 498 & EECS 598; Prof. Satish Narayanasamy)

ADVANCED ANALOG AND MIXED SIGNAL CIRCUITS
(EECS 598; Prof. Michael Flynn)

ADVANCED DATA MINING
(EECS 598; Prof. Danai Koutra)

ADVANCED OS PROJECTS
(EECS 498; Profs. Peter Chen, Baris Kasikci, & Manos Kapritsos)

AI APPLICATIONS IN ELECTRICAL ENGINEERING
(EECS 598; Prof. Jarir Chaar)

ANALYSIS OF ELECTRIC POWER DISTRIBUTION SYSTEMS AND LOADS
(EECS 598; Prof. Johanna Mathieu)

APPLIED GPU PROGRAMMING
(EECS 498 & EECS 598; Prof. Reetuparna Das)

ARTIFICIAL INTELLIGENCE APPLICATION IN ELECTRICAL ENGINEERING
(EECS 598; Prof. Jarir Chaar)

BIG DATA SYSTEMS AND APPLICATION
(EECS 598; Prof. Mosharaf Chowdhury)

BRAIN-LIKE COMPUTING
(EECS 598; Prof. Pinaki Mazumder)

CENSORSHIP AND PRIVACY TECHNOLOGY
(EECS 598; Prof. Roya Ensafi)

COMPUTATIONAL MODELING IN HCI
(EECS 598; Prof. Nikola Banovic)

COMPUTING FOR COMPUTER SCIENTISTS
(EECS 398; Lec. Marcus Darden)

CONVERSATIONAL ARTIFICIAL INTELLIGENCE
(EECS 498; Prof. Jason Mars)

CROWDSOURCING AND HUMAN AI INTERACTION
(EECS 598; Prof. Walter Lasecki)

CS EDUCATION RESEARCH
(EECS 498; Prof. Mark Guzdial)

CYBERSECURITY FOR FUTURE LEADERSHIP
(EECS 498; Profs. Javed Ali & Carl Landwehr)

DEEP LEARNING
(EECS 498; Prof. Honglak Lee)

DEEP LEARNING FOR VISION
(EECS 498 & EECS 598; Prof. Justin Johnson)

DIGITAL SIGNAL PROCESS DESIGN
(EECS 498; Prof. Hun Seok Kim)

ELECTION CYBERSECURITY
(EECS 498; Prof. J. Alex Halderman)

ELECTRICAL ENGINEERING SYSTEM DESIGN I
(EECS 298; Prof. Jamie Phillips)

ELECTRICAL ENGINEERING SYSTEM DESIGN II
(EECS 398; Prof. Brian Gilchrist)

ENGINEERING INTERACTIVE SYSTEMS FOR HCI
(EECS 598; Prof. Alanson Sample)

GAN-BASED ELECTRONIC DEVICES
(EECS 598; Prof. Elaheh Ahmadi)

GREEN'S FUNCTIONS IN ELECTROMAGNETICS WITH APPLICATIONS
(EECS 598; Prof. Leung Tsang)

HARDWARE FOR MACHINE LEARNING
(EECS 598; Prof. Zhengya Zhang)

INTRO TO AUTONOMOUS ROBOTICS
(EECS 398; Prof. Chad Jenkins)

INTRO TO EMBEDDED SYSTEMS RESEARCH
(EECS 598; Prof. Robert Dick)

MODELING HUMAN BEHAVIOR
(EECS 498; Prof. Nikola Banovic)

MULTIDISCIPLINARY MDE PILOT
(EECS 498; Prof. Jay Guo)

MULTIDISCIPLINARY SOFTWARE DEVELOPMENT
(EECS 498; Dr. Jeff Ringenberg)

NATURAL LANGUAGE PROCESSING
(EECS 498; Prof. Rada Mihalcea)

OPTIMIZATION FOR SIGNAL PROCESSING
(EECS 598; Prof. Jeff Fessler)

PLASMA CHEMISTRY AND PLASMA SURFACE INTERACTIONS
(EECS 598; Prof. Mark Kushner)

QUANTUM OPTOELECTRONICS
(EECS 598; Prof. Mackillo Kira)

RADIOWAVE PROPAGATION & LINK DESIGN
(EECS 498; Prof. Brian Gilchrist)

SURVEILLANCE LAW & TECHNOLOGY
(EECS 598; Profs. J. Alex Halderman and Margo Schlanger)

SYSTEM DESIGN IN C++
(EECS 398; Lec. Nicole Hamilton)

SYSTEM DESIGN OF A SEARCH ENGINE
(EECS 398; Lec. Nicole Hamilton)

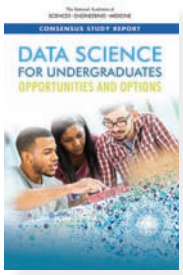
TOPICS IN HARDWARE SECURITY
(EECS 598; Prof. Daniel Genkin)

Course Highlight

RANDOM MATRIX THEORY SUMMER SCHOOL

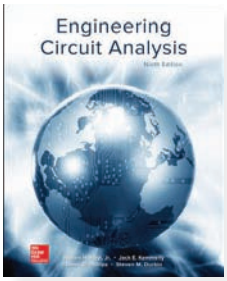
Prof. Raj Nadakuditi partnered with Prof. Jinho Baik from the Mathematics Department to develop a two-week long summer school. The program is for graduate students and beginning postdocs with some basic working knowledge of random matrix theory. The goal is to provide an opportunity for participants to learn new techniques different from their own background and to understand how/when/where these techniques can/have/should be applied. The program attracted over 60 graduate students last year.

NEW BOOKS



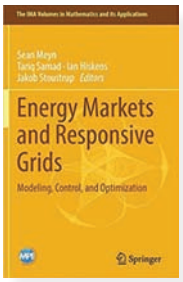
Data Science for Undergraduates: Opportunities and Options

Prof. Alfred Hero co-authored a book for the National Academies of Sciences, Engineering, and Medicine that offers a vision for the emerging discipline of data science at the undergraduate level and includes considerations and approaches for academic institutions.



Engineering Circuit Analysis

Prof. Jamie Phillips co-authored a book published by McGraw-Hill that is designed for students to learn the basics of circuit analysis without the need for a traditional classroom environment.



Control at Large Scales: Energy Markets and Responsive Grids

Prof. Ian Hiskens co-edited a book published by Springer that contains essays from the participants of the workshop *Control at Large Scales: Energy Markets and Responsive Grids*, which focused on current and future challenges in energy markets and controls, along with potential solutions.

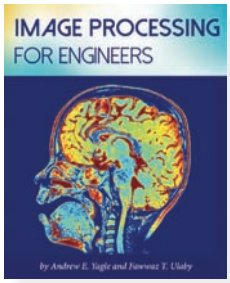


Image Processing for Engineers

Prof. Fawwaz Ulaby co-authored a textbook on image processing published by Michigan Publishing. This is part of an effort by U-M professors to ease the financial burden on students by offering free digital and low-cost printed textbooks.

RETIREMENTS

KEVIN COMPTON

Prof. Kevin Compton retired from the department in December 2018, after 34 years on the faculty.

Prof. Compton's research interests have been in the areas of complexity of combinatorial and logical problems, analysis of algorithms, and automata theory. His work spanned compiler synthesis, formal verification of programs and software engineering tools, cryptographic protocol verification, and development of probabilistic methods for the analysis of algorithms.

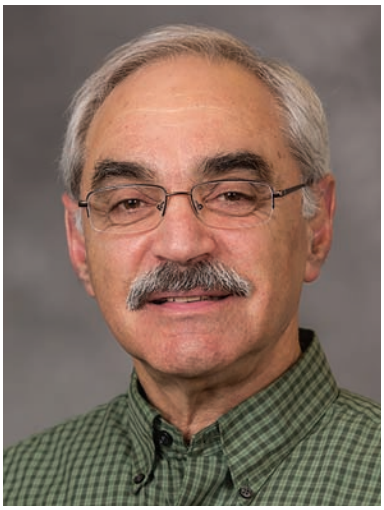
Outside of research and teaching, Prof. Compton served as head coach and mentor for University of Michigan student programming teams since 2001, and eight times coached teams that have advanced to the very competitive ACM International Collegiate Programming Contest World Finals. In 2011, the Michigan team placed second in the world, a remarkable achievement. In 2014, Prof. Compton was recognized with the ACM-ICPC Coach Award for having at that time brought five teams to world finals competition.

Prof. Compton received his BA (with distinction) in Mathematics in 1974 from the University of Colorado-Boulder. He went on to the University of Wisconsin where he received his MA in Mathematics in 1976, his MS in Computer Science in 1980, and his PhD in Mathematics in 1980.

Prof. Compton joined the faculty during a pivotal moment in the history of CS at Michigan. He was recruited by Gideon Frieder, who at the time was Chair of the Computer and Communication Sciences (CCS) Department in the College of LSA and was interested in recruiting theoretical computer scientists. In 1984 – the year that Prof. Compton was hired – was the year that CCS merged with the ECE Department and a separate CISE grad program in the College of Engineering to form what is today's EECS Department. As a result, Prof. Compton was one of the first faculty members hired into the new EECS Department and is one of a very few remaining with ties to the old CCS.

Prof. Kevin Compton in 2014, after receiving the ACM-ICPC Coach Award.

Prof. Compton confers with the Michigan programming team at the 2018 ACM-ICPC world finals in Beijing.



DAVID L. NEUHOFF

Prof. Dave Neuhoff, an internationally recognized expert in information theory, source coding, and image processing, retired this year after 45 years of championing students, faculty, and the department.

Neuhoff, the Joseph E. and Anne P. Rowe Professor of Electrical Engineering, is particularly well known for his contributions to the development of universal source coding, causal source coding, and high-resolution quantization theory. He has authored 217 publications and 6 patents. He is a Fellow of IEEE and served as president of the IEEE Information Theory Society in 2006.

In the 1980's, Neuhoff chaired the CICE interdepartmental program review committee whose restructuring proposal played a role in forming the current EECS Department. Then, as an associate chair, he led the development of its new graduate programs, the expansion of its PhD programs, and its growth in the systems areas of electrical engineering. In the 1990's, he chaired the committee that proposed the restructuring of the EE undergraduate program that currently enables students to consistently graduate in four years. He also served as Associate Chair from 2008 to 2018, with a principal focus on graduate affairs.

Neuhoff received the College of Engineering (CoE) 1938E Award, the CoE Service Excellence Award, and the CoE Stephen S. Atwood Award, which is the college's highest honor bestowed on faculty. He also received the IEEE Information Theory Society Service Award for his leadership in bringing statues of Claude Shannon (U-M alumnus and father of information theory) to a number of locations, including the University of Michigan. Shannon's legendary 1948 paper, "The Mathematical Theory of Communication" unveiled the vast potential for digital communications and inspired virtually all of the work in digital communications that followed. Neuhoff later helped organize the *Shannon Centennial Symposium*, held at U-M.

In addition to his generosity as a colleague, Neuhoff is known for his excellence in student mentorship and education. He was honored with a 2015 Rackham Distinguished Graduate Mentor Award for his sustained efforts as advisor, teacher, advocate, sponsor, and role model to doctoral students. He supervised 32 doctoral dissertations, and his students have gone on to become leaders in industry and academia, with seven holding tenure or tenure-track positions at major institutions of higher education. These alumni praise him for his patient and meticulous mentorship, which helped them to develop into creative and independent thinkers with a solid theoretical foundation.

"I've always depended on the brilliance of students," Neuhoff said. "I owe a tremendous amount to them. I'm grateful to hear them thank me, but it's really me who should thank them."

Dave Neuhoff (right) and Al Hero next to the Claude E. Shannon statue Neuhoff helped bring to the University of Michigan (and to five other locations across the country).

KIM A. WINICK

After 31 years, Prof. Winick has retired, leaving a legacy that empowers students to seek life and learning outside of the lab.

Winick received his BS degree in Electrical Engineering, summa cum laude, from Pennsylvania State University in 1976. Dave Neuhoff, the Joseph E. and Anne P. Rowe Professor Emeritus of Electrical Engineering, was instrumental in recruiting Winick to come to U-M for his graduate work.

As a graduate student, Winick's advisor was Emmett Leith, the inventor of practical holography along with Juris Upatnieks. Leith's impact on optics is world-renowned, and Winick ranks him as one of the most famous people to have ever come from our department. Winick remembers him as a kind, funny, brilliant, and unique individual.

Winick's research interests have focused on glass and crystal integrated optics, nanophotonics, communications, and information theory. He and his colleagues and students were among the first to refine and apply a technique using ultrashort laser pulses to fabricate optical devices that is widely used today. He also made substantial contributions to active and integrated optical devices in glasses and crystals, and he's a Fellow of the Optical Society of America (OSA).

One of Winick's strongest legacies at Michigan is his teaching and advising. Winick served as the Chief Program Advisor for Electrical Engineering for many years. He taught a dozen different undergraduate and graduate courses, and he revised the first required undergraduate Systems course and developed all its accompanying labs.

Winick also helped create a study abroad program for U-M engineers that is taught in France each summer, which is part of U-M's College of Engineering International Programs in Engineering (IPE). Winick is a strong proponent of study abroad programs, for he believes such programs are important to a student's overall experience and education.

"The older one gets, the more one realizes that friends and relationships are the heart of the satisfying life," Winick said in farewell, addressing his friends, colleagues, and former students at his retirement reception. "It has been a distinct honor to help educate the next generation. Thanks again for making my time at U-M great fun. Go blue!"

Special Awards for Faculty and Staff

Ann Stals, ECE Alumni Engagement and Events Manager, received the CoE Staff Excellence Award, and was recognized for her overall excellence in planning and executing a wide range of events for students, staff, faculty, and alumni.

Jamie Phillips, Professor of Electrical and Computer Engineering, received the CoE Staff-Faculty Partnership Award, and was recognized for his exceptional collaborative skills and his commitment to fostering a culture of daring, leadership, and inclusivity.

Rose Anderson, EECS Graphic Designer, received a Bronze Award from the Council for Advancement and Support of Education for her *MI Alphabet Book*, which is presented to alumni in special circumstances, and faculty who are new parents of infants and children.

Anne Rhoades, ECE Human Resources Manager, was a finalist for the Top HR Professional Award given by the Michigan Society of Human Resource Management, which recognizes excellence in Human Resources in Business and Community.

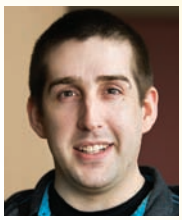
COE Creativity, Innovation, and Daring Awards

This College of Engineering program aims "to reward and recognize staff and faculty who take extra steps to advance the college and whose achievements embody a forward-thinking approach to fostering College values and building its culture." The following individuals were recognized for special contributions to the College community.

Lisa Armstrong
Department Administrator for ECE

David DeWeerd
Financial Analyst

Michael Flynn
Professor



Jacob Hayward
EECS Applications Programmer

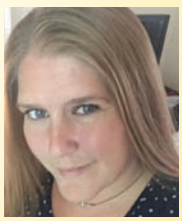
David Neuhoff
Joseph E. and Anne P. Rowe Professor Emeritus of Electrical Engineering

Stephanie O'Keefe
Research Area Specialist

Anne Rhoades
Senior Human Resources Generalist

Stacie Printon
Senior Assistant to the Chair

Stephen Reger
Purchasing Lead



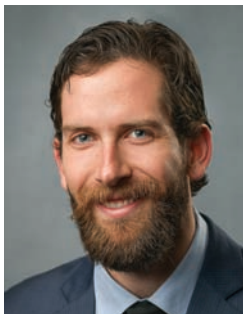
Kristen Thornton
PhD Graduate Coordinator

FACULTY NEWS

NEW FACULTY

MICHAEL ADAMS
Assistant Research Scientist
PhD, Computer Science, 2011
Indiana University

Michael's research is centered on programming languages, with an emphasis on static analysis and cybersecurity, parsing, and generic programming and meta-programming. His goal is to develop next-generation languages and techniques that improve the process of programming, and to help programmers to more easily implement, reason about, improve the performance of, and secure their code.



JONATHAN BEAUMONT
Lecturer III
PhD, Computer Science and Engineering, 2019
University of Michigan

Jon has served as an Instructional Aid in EECS 270, and as a primary instructor and a GSI in EECS 470. He was recognized by the EECS Department in 2014 and by the College of Engineering in 2015 for his excellent work in the latter. He has served on the CS Kickstart staff, a program designed to acclimate incoming first-year women to the discipline, and as a teaching consultant with CRLT-Engin.

JOYCE CHAI
Professor
PhD, Computer Science, 1998
Duke University

Joyce joins the department from Michigan State University, where she has been on the faculty since 2003. Her research is in natural language processing and human-machine conversation. Her recent work explores the intersection between language, vision, and robotics to improve communication with robots and other artificial agents. She has an excellent record in the classroom, teaching core AI as well as courses on natural language processing and language interaction. Prior to MSU, she was a research staff member at IBM T.J. Watson Research Center.

MAHDI CHERAGHCHI
Assistant Professor
PhD, Computer Science, 2010
Swiss Federal Institute of Technology (EPFL)

Mahdi joins EECS from the Imperial College London, where he has been on the faculty since 2015. He is broadly interested in all theoretical aspects of computer science, especially the role of information and coding theory in cryptography, complexity, algorithms, and high-dimensional geometry. Previously, he has held post-doctoral appointments at UC Berkeley, MIT, Carnegie Mellon, and UT Austin, and as a visiting engineer at Qualcomm. At EPFL, he received the Patrick Denantes Memorial Prize for outstanding doctoral thesis in the School of Computer and Communication Sciences.

ROBERT GREGG
Associate Professor
PhD, Electrical and Computer Engineering, 2010
University of Illinois at Urbana-Champaign

Robert's research concerns the control mechanisms of human locomotion with applications to wearable and autonomous robots. He comes from the Departments of Bioengineering and Mechanical Engineering at the University of Texas at Dallas (UTD) where he worked as an assistant professor and was Director of the Locomotor Control Systems Laboratory. Prior to joining UTD, he was a research scientist at the Rehabilitation Institute of Chicago and a postdoctoral fellow at Northwestern University. He has received an NSF CAREER Award, NIH Director's New Innovator Award, and Burroughs Wellcome Fund Career Award at the Scientific Interface.

EUIWOONG LEE
Assistant Professor
PhD, Computer Science, 2017
Carnegie Mellon University

Euiwoong's research interests include topics in optimization algorithms and complexity theory, such as approximation algorithms, hardness of approximation, sum-of-squares hierarchies, and parameterized algorithms. He is a recipient of the Edmund M. Clarke Doctoral Dissertation Award, an ICALP Best Student Paper Award, and the Simons Award for Graduate Students in Theoretical Computer Science. He is currently a post-doctoral researcher at the Computer Science Department of New York University and will join the department in September 2020.

NEW FACULTY

CYRUS OMAR
Assistant Professor
PhD, Computer Science, 2017
Carnegie Mellon University

Cyrus applies type-theoretic and cognitive principles to design next-generation user interfaces for programming languages. He currently leads the development of Hazel (hazel.org), a live functional programming environment that understands incomplete programs, i.e., programs with holes. He is ultimately interested in improving the programming experience for computational and data scientists, web application programmers, students and educators, and for people with limited mobility and other disabilities who cannot effectively use other programming tools. Cyrus was previously a postdoctoral researcher at the University of Chicago. He started his research career as a theoretical neurobiologist before deciding to focus on augmenting human cognition with better programming tools.

ANDREW OWENS
Assistant Professor
PhD, Electrical and Computer Engineering, 2016
Massachusetts Institute of Technology

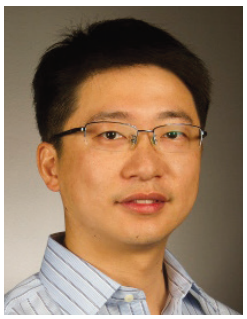
Andrew works in the area of computer vision, with a special focus on creating multimodal perception systems that combine sight, sound, and touch. Inspired by how humans learn from associations among senses, he has developed computational models that learn about the world by finding structure in multimodal sensation. Andrew was previously working as a postdoc at UC Berkeley, and will join the department January 2020.

PETER SEILER
Associate Professor
PhD, Mechanical Engineering, 2001
University of California, Berkeley

Peter works in the area of robust control theory which focuses on the impact of model uncertainty on systems design. He is a co-author of the *Robust Control Toolbox in Matlab*. He is currently developing theoretical and numerical algorithms to assess the robustness of systems on finite time horizons. He is also investigating the use of robust control techniques to better understand optimization algorithms and model-free reinforcement learning methods. He joins Michigan from the University of Minnesota, where he has been working on advanced control techniques for wind turbines, fault-detection methods for safety-critical systems, and robust control of disk drives. Peter will join the department January 2020.

XINYU WANG
Assistant Professor
PhD, Computer Science, 2019
University of Texas at Austin

Xinyu is interested in developing foundational program synthesis techniques that are applicable to automating real-world programming tasks (in application domains such as data wrangling, databases, machine learning, security, etc) by combining formal methods, programming languages, and machine learning. He is also interested in developing and applying program analysis techniques in the context of software security and software engineering. Xinyu is currently a researcher at Microsoft and will join the department in September 2020.



LEI YING
Professor
PhD, Electrical and Computer Engineering, 2007
University of Illinois at Urbana-Champaign

Lei's research is broadly in the interplay of complex stochastic systems and big-data, including large-scale communication/computing systems for big-data processing, reinforcement learning, private data marketplaces, and large-scale graph mining. He will be joining Michigan from Arizona State University, where he is a professor with the Electrical, Computer, and Energy Engineering Department. He has co-authored two books, including a popular textbook in communication networks used here at Michigan. He received a Young Investigator Award from the Defense Threat Reduction Agency (DTRA) in 2009 and NSF CAREER Award in 2010.

Early Career Awards

LAURA BALZANO
NSF CAREER AWARD

Project Title: *Robust, Interpretable, and Efficient Unsupervised Learning With K-set Clustering*

Balzano aims to improve machine learning for big data applications involving elaborate physical, biological, and social phenomena. Her research deciphering messy data sets will first tackle applications in genetics and computer vision.

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH YOUNG INVESTIGATOR AWARD

Project Title: *Non-convex Optimization Algorithms and Theory for Matrix Factorization With Dynamic Massive Data*

Balzano aims to improve machine learning for big data applications involving elaborate physical, biological, and social phenomena. Her research deciphering messy data sets will first tackle applications in genetics and computer vision.

ARMY RESEARCH OFFICE YOUNG INVESTIGATOR AWARD

Project Title: *Mathematics for Learning Nonlinear Generalizations of Subspace Models in High Dimensions*

Balzano will work to improve high-dimensional big data problems, which apply to managing large networked systems, such as sensor networks, power grids, or computer networks.

MOSHARAF CHOWDHURY
NSF CAREER AWARD

Project Title: *End-to-End Network Design for Unified Memory Disaggregation*

This project takes advantage of new technologies in Remote Direct Memory Access (RDMA) to connect all the unused memory in a data cluster and treat it as a single, massive memory unit, increasing overall efficiency.

REETUPARNA DAS
SLOAN RESEARCH FELLOWSHIP

Das will develop new architectures for in-memory computing that improve performance by orders of magnitude to meet computing demand in the post Moore's Law future.

HUN-SEOK KIM
DARPA YOUNG FACULTY AWARD

Project Title: *Hyper-Dimensional Modulation for Robust Low-Latency Low-Power IoT Networks*

Kim's research is expected to impact the future design and wireless operation of the next generation of Internet of Things (IoT) devices, which includes intelligent control of devices such as drones and self-driving cars.

DANAI KOUTRA
NSF CAREER AWARD

Project Title: *Timely Insights: Interpretable, Multi-scale Summarization of Networks Over Time*

This project will tackle problems in summarizing network data at different scales to accomplish feats from speeding up web searches to better understanding the structure of the human brain.

WALTER LASECKI
DARPA YOUNG FACULTY AWARD

Project Title: *Hybrid Intelligence Agents for Deploying Robust AI Systems*

Lasecki will work to create "hybrid intelligent agents," in which artificial intelligence is augmented by human crowdsourcing to address the shortcomings of machine learning when unexpected or novel scenarios arise. His proposal explores techniques that will work in critical and time-sensitive domains.

JOHANNA MATHIEU
NSF CAREER AWARD

Project Title: *Stochastic Capacity Scheduling and Control of Distributed Energy Storage Enabling Stacked Services*

Mathieu will work to build a smarter, cleaner grid by ensuring the reliability of electric power systems that rely heavily on sustainable energy sources. She plans to develop new optimization and control methods to leverage the flexibility available from distributed energy resources (DERs), such as energy storage and flexible loads.

LINGJIA TANG
NSF CAREER AWARD

Project Title: *QoS-aware Systems for Accelerated Data Centers*

Tang's project addresses the challenge of providing sufficient and efficient infrastructure to meet the increasing computational demands of Artificial Intelligence and Machine Learning applications in large data centers. Her goal is to redesign datacenter systems to support acceleration at scale to meet the future computational demand.

Professorships

CSE Chair Brian Noble, Engineering Dean Alec Gallimore, Toyota Professor of Artificial Intelligence Satinder Singh Baveja, and Chief Science Officer at Toyota Research Institute Dr. Eric Krotkov.

Satinder Singh Baveja Named the Inaugural Toyota Professor of Artificial Intelligence

Prof. Baveja's research focus is on developing the theory, algorithms, and practice of building artificial agents that can learn from interaction in complex, dynamic, and uncertain environments, including environments with other agents in them. His main contributions have been to the areas of reinforcement learning, multi-agent learning, and more recently to applications in cognitive science and healthcare.

Recent major projects include leading Project Sapphire, funded by IBM, that brought together 16 U-M faculty and students together to build AI technologies to advance the state of the art on conversational systems. Prof. Baveja also serves as faculty liaison for U-M's collaboration with Toyota Research Institute.

Prof. Baveja is a Fellow of the AAAI (Association for the Advancement of Artificial Intelligence) and has coauthored more than 150 peer-reviewed papers in journals and conferences and has served on many program committees. He served as Program Co-chair for the *31st AAAI Conference (AAAI-17)*. He helped cofound *RLDM (Reinforcement Learning and Decision Making*), a multidisciplinary meeting that brings together computer scientists, psychologists, neuroscientists, roboticists, control theorists, and others interested in animal and artificial decision making.

A $3 Million gift from Toyota Motor Corporation endowed the professorship and provides additional funding to support assistant or recently tenured associate faculty members on AI or robotics projects.

Stéphane Lafortune

N. Harris McClamroch Collegiate Professor of Electrical Engineering and Computer Science

Stéphane Lafortune has been named the N. Harris McClamroch Collegiate Professor of Electrical Engineering and Computer Science in recognition of his distinguished record of teaching and research.

Prof. Stéphane Lafortune is an international leader in discrete event systems (DES). His research in DES includes multiple problem domains: modeling, diagnosis, control, optimization, and applications to computer and software systems.

Recently, his research has been focused on cyber-physical and networked systems, cybersecurity, and privacy. Applications include software systems, automated manufacturing systems, communication networks, document processing systems, process control systems, and transportation systems.

Engineering Dean Alec Gallimore, Prof. N. Harris McClamroch, Prof. Stéphane Lafortune, and ECE Chair Mingyan Liu.

Lafortune is a Fellow of the IEEE (1999) and of the International Federation of Automatic Control (2017). He received the Presidential Young Investigator Award from the National Science Foundation in 1990 and the Axelby Outstanding Paper Award from the Control Systems Society of the IEEE in 1994 (for a paper co-authored with S.-L. Chung and F. Lin) and in 2001 (for a paper co-authored with G. Barrett).

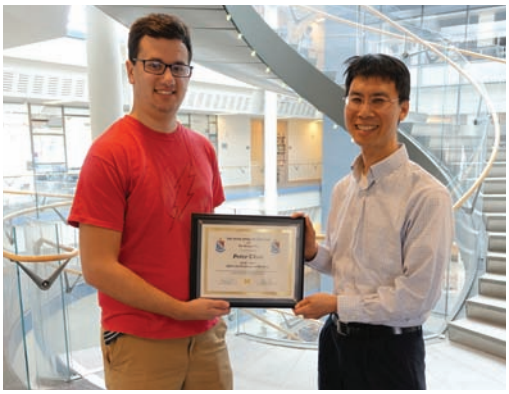
He is also known for excellence as a teacher, and received this year's "Professor of the Year Award," which is an award given by students.

HKN

PROFESSORS OF THE YEAR 2019

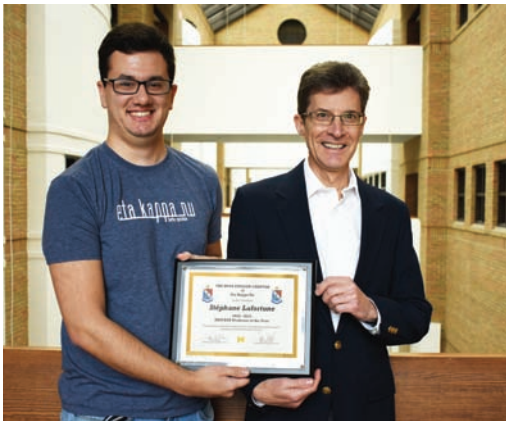
Each year, the U-M chapter of Eta Kappa Nu, the national honor society for electrical and computer engineers, selects two faculty for recognition, one from each division of EECS. The recipients are selected based on a vote by the students.

PETER CHEN (CSE)



Joshua Setnicky (HKN President, Winter 2019) and Prof. Peter Chen.

STÉPHANE LAFORTUNE (ECE)



Joshua Setnicky (HKN President, Winter 2019) and Prof. Stéphane Lafortune.

EECS Outstanding Achievement Awards

ECE Chair Mingyan Liu, CSE Chair Brian Noble, Prof. Valeria Bertacco, and CSE Associate Chair for External Affairs Thomas Wenisch.

VALERIA BERTACCO is recognized for leadership of the ADA Research Center; service on the College of Engineering Executive Committee and as Associate Dean for Physical Sciences and Engineering at the Rackham Graduate School; contributions to the betterment of women in higher education; and highly recognized research in specialized architectures.

ECE Chair Mingyan Liu, CSE Chair Brian Noble, Prof. Robert Dick, and ECE Senior Associate Chair Dennis Sylvester.

ROBERT DICK is recognized for co-developing the freshman course, Self-Driving Cars, Drones, and Beyond: An Intro to Autonomous Electronic Systems; serving as chair of the computer engineering program committee, and for outstanding research in embedded systems spanning software and hardware.

EECS Outstanding Achievement Awards

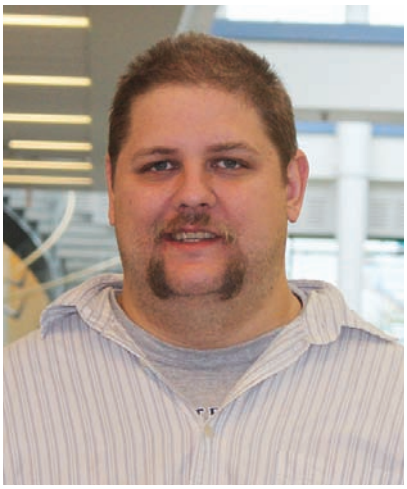
ECE Chair Mingyan Liu, CSE Chair Brian Noble, Prof. Rada Mihalcea, and Prof. Benjamin Kuipers.

RADA MIHALCEA is recognized for outstanding research on natural language and multi-modal interaction among humans and between humans and computational systems, including deception, emotion, and humor; for service in support of diversity in computer science; and for leadership as Director of the Artificial Intelligence Laboratory.

ECE Chair Mingyan Liu, CSE Chair Brian Noble, Prof. Vijay Subramanian, and Prof. Dave Neuhoff.

VIJAY SUBRAMANIAN is recognized for his outstanding contributions to research in resource allocation and learning in networks with strategic users, and for developing the senior undergraduate/graduate course: Introduction to Social, Economic and Technological Networks.

EECS Honors



RON DRESLINSKI was named Morris Wellman Faculty Development Professor, which recognizes junior faculty members in the Computer Science and Engineering division.

JOHANNA MATHIEU received the Ernest and Bettine Kuh Distinguished Faculty Award, which recognizes junior faculty members in the Electrical and Computer Engineering division.

Faculty Honors, Awards, and Activities

EHSAN AFSHARI received the Best Invited Paper Award at the *2019 IEEE Custom Integrated Circuits Conference* for the paper "Fully Integrated Solutions for High Resolution Terahertz Imaging," which provided an overview of the state of the art in terahertz imaging.

BILL ARTHUR received the Thomas M. Sawyer, Jr. Teaching Award, which recognizes distinguished lecturers at the U-M College of Engineering.

TODD AUSTIN received the Distinguished Faculty Achievement Award, which recognizes outstanding senior faculty at the University of Michigan. He, along with his co-authors, also received the IEEE/ACM MICRO Test of Time Award for "Diva: a reliable substrate for deep submicron microarchitecture design," originally published in 1999.

LAURA BALZANO was awarded a Fulbright Scholarship to develop new machine learning methods that will improve precision medicine with applications in medical imaging for cancer diagnosis and health outcome prediction from electronic medical record (EMR) time series data.

SATINDER SINGH BAVEJA, the Toyota Professor of Artificial Intelligence has received the 2019 Classic Paper Award from *Artificial Intelligence Journal* for his 1998 paper, "Between MDPs and semi-MDPs: A framework for temporal abstraction in reinforcement learning." He also served as Associate Editor-in-Chief for the *Journal of Artificial Intelligence Research.*

VALERIA BERTACCO, Arthur F. Thurnau Professor, received the Harold R. Johnson Diversity Service Award, which recognizes contributions to a culturally and ethnically diverse campus community within the University of Michigan.

PALLAB BHATTACHARYA, the Charles M. Vest Distinguished University Professor and James R. Mellor Professor of Engineering, received the 2019 IEEE Jun-ichi Nishizawa Medal along with Profs. Yasuhiko Arakawa and Dieter Bimberg "for contributions to the development and commercialization of quantum dot lasers."

Prof. Bhattacharya also received the 2018 Molecular Beam Epitaxy Innovator Award, awarded by the *North American MBE Conference and Advisory Board*, for fundamental contributions to molecular beam epitaxy of quantum confined and nanoscale heterostructures and optoelectronic devices realized with them.

MICHAEL CAFARELLA and his collaborators have been awarded a 2018 Very Large Databases (VLDB) 10-Year Test-of-Time Award for their paper, "WebTables: exploring the power of tables on the web," originally published in 2008. He also delivered a plenary award keynote at *Very Large Databases (VLDB) 2018*.

DAVID CHESNEY was named Toby Teorey Collegiate Lecturer by the College of Engineering.

KEVIN COMPTON associate professor emeritus, received the Herbert Kopf Service Excellence Award from the College of Engineering.

LYNN CONWAY, professor emerita, received an honorary Doctor of Science degree at U-M's Winter 2018 Commencement.

Photo credit: Daryl Marshke, Michigan Photography

REETURPARNA DAS received a 2019 Sloan Research Fellowship by the Alfred P. Sloan Foundation for her research developing novel hardware architectures.

STEPHEN FORREST, the Peter A. Franken Distinguished University Professor and Paul G. Goebel Professor of Engineering, served as keynote speaker at the *2019 Symposium of the Princeton Institute for the Science and Technology of Materials*. He was also elected Fellow of the American Academy of Arts and Sciences, and he received an honorary doctorate from Technion - Israel Institute of Technology.

JIM FREUDENBERG received an alumni Career Achievement Award from Rose-Hulman Institute of Technology.

CINDY FINELLI served as Deputy Editor for the *Journal of Engineering Education*.

KEVIN FU and his coauthors received the IEEE Security and Privacy Test of Time Award for "Pacemakers and Implantable Cardiac Defibrillators: Software Radio Attacks and Zero-Power Defenses," originally published in 2008. He also served as the Cybersecurity Task Force Chair for the CRA's Computing Community Consortium Council, and delivered keynote addresses at the following events:

the *Medtronic Electrophysiology Fellows Conference*, the *Archimedes Medical Device Security 101 Conference*, the *Asia Conference on Computer and Communications Security*, the *Heart Rhythm Society Annual Conference of Electrophysiology*, *UCSD Cardiac Electrophysiology*, the *Cryptacus Conference*, and *U-M SUMIT*.

ANTHONY GRBIC received the Faculty Recognition Award, which recognizes outstanding mid-career faculty at the University of Michigan.

BRENT GRIFFIN won the first and second Toyota Research Institute Human Support Robot (HSR) challenges that are held between University of Michigan, MIT, Stanford, Berkeley, and other schools.

MARK GUZDIAL received the ACM SIGCSE Award for Outstanding Contribution to Computer Science Education and delivered the keynote addresses at the following events: *FabLearnDK 2019*, *SIGCSE 2019*, and *To Code and Beyond* at Cornell Tech. He was an organizer for the *Dagstuhl Seminar on Notional Machines and Programming Language Semantics in Education.*

J. ALEX HALDERMAN was named a 2019 Andrew Carnegie Fellow, which recognizes those offering a fresh perspective on a pressing challenge of our time. He was also the keynote speaker for *Detection of Intrusions and Malware and Vulnerability Assessment (DIMVA 2018).*

ALFRED HERO, the John H. Holland Distinguished University Professor of EECS and R. Jamison and Betty Williams Professor of Engineering, received the 2020 IEEE Fourier Award, an IEEE technical field award, "for contributions to the foundations of statistical signal processing with applications to distributed sensing and performance benchmarking." He was the plenary speaker at the *2018 French Statistical Society Conference*, and the keynote speaker at the *2018 IEEE International Conference on Signal Processing, Communications and Computing*.

HV JAGADISH, the Bernard A. Galler Collegiate Professor of EECS, served as Editor-in-Chief for the *Morgan Kaufman Synthesis Lecture Series on Data Management* and delivered the keynote address at the *SIGMOD Workshop on Artificial Intelligence and Data Mining (AIDM).*

CHAD JENKINS has been appointed a member of the Computing Research Association's Computing Community Consortium Council, and also served as Editor-in-Chief for the *ACM Transactions on Human-Robot Interaction*. He delivered the keynote address at the following events: the *2018 Notre Dame Future Faculty Workshop*, the *NewSchools Venture Summit*, and *Robotics: Science and Systems (RSS)*.

MACKILLO KIRA has been elected a Fellow of the Optical Society (OSA) for "pioneering contributions to the theory of semiconductor quantum optics."

DANAI KOUTRA delivered the keynote address at the following events: the *56th Annual Allerton Conference on Communication, Control and Computing,* the *Dagstuhl Seminar on High-Performance Graph Algorithms*, the *Graph Exploitation Symposium (GraphEX 2018)*, and the *Porto Winter School on Network Science*.

BEN KUIPERS delivered the keynote address at the *TTI Vanguard Conference on Intelligence, Natural and Artificial.*

MARK J. KUSHNER, the George I. Haddad Professor of Electrical Engineering and Computer Science, was awarded the von Engle and Franklin Prize by the *International Conference on Phenomena in Ionized Gases*.

STÉPHANE LAFORTUNE was a keynote speaker at the *6th International Conference on Control, Decision and Information Technologies (CoDiT 2019).*

JOHN LAIRD, the John L. Tishman Professor of Engineering, received the 2018 Herbert A. Simon Prize in Cognitive Systems for his sustained work in developing the Soar architecture, and delivered the keynote address at the *NIPS Workshop on Learning by Instruction.*

WALTER LASECKI served as Co-Editor-in-Chief of the *Human Computation Journal.*

RADA MIHALCEA received the Sarah Goddard Power Award and the Carol Hollenshead Award from the Center for the Education of Women for efforts on behalf of women and community equity. She also delivered the keynote address at the following events: *IEEE Southeast Michigan Chapter Conference, 13th International Conference on Linguistic Resources and Tools for Processing Romanian Language, COLING Workshop on Trolling, Aggression, and Cyberbullying, NAACL Workshop on Stylistic Variation, Midwest Speech and Language Days, IEEE Workshop on Multimodal Representation, 2019 Annual Conference of the North American Chapter of the Association for Computational Linguistics,* and *NAACL Workshop on Natural Language Processing and Computational Social Science.*

ERIC MICHIELSSEN, the Louise Ganiard Johnson Professor of Engineering, served as Editor-in-Chief for the *International Journal of Numerical Modelling, Electronic Networks, Devices, and Fields*.

AMIR MORTAZAWI received the 2019 Microwave Theory and Techniques Society Distinguished Educator Award.

TREVOR MUDGE, the Bredt Family Professor of Engineering, received the Most Impactful Paper Award at the *International Conference on High-Performance Computing Silver Jubilee* for "Power: A first class design constraint for future architectures," originally published in 2000. He also delivered the keynote address at the *4th Annual SARC Technology Forum Emerging Challenges in Microprocessor Design*.

ADIB NASHASHIBI received the IEEE Certificate of Appreciation for notable services and contributions towards the advancement of IEEE and the engineering professions as Chair of local chapter of the Geoscience and Remote Sensing Society.

EDWIN OLSON delivered the keynote address at the *CVPR Workshop on Autonomous Driving.*

NECMIYE OZAY received the Henry Russel Award, considered the University of Michigan's highest honor for faculty at the early to mid-career stages of their career.

SETH PETTIE delivered the keynote address at the following events: China Theory Week 2018, the *2nd Workshop on Local Algorithms, International Colloquium on Structural Information and Communication Complexity (SIROCCO) 2018*, the *Highlights of Algorithms (HALG) Conference*, and the *Advances in Distributed Graph Algorithms (ADGA) Conference*.

ATUL PRAKASH delivered the keynote address at the *14th International Conference on Information Systems Security.*

STEPHEN RAND was elected Fellow of the American Physical Society for outstanding contributions to precision optical spectroscopy, laser physics, and the exploration of ultrafast magneto-electric interactions at the molecular level.

KAMAL SARABANDI, the Rufus S. Teesdale Professor of Engineering, served as Chair of Commission F, United States National Committee for the International Union of Radio Science (USNC/URSI).

He also led a panel to review the College of Engineering and School of Electrical Engineering at Aalto University in Finland, and welcomed the Emperor and Empress of Japan at the 2019 *IEEE Geoscience and Remote Sensing Symposium*.

KANG G. SHIN, the Kevin and Nancy O'Connor Professor of Computer Science, delivered the keynote address at the *7th ACM Conference on Data and Application Security and Privacy (CODASPY 2017)*.

ELLIOT SOLOWAY served as Co-Editor-in-Chief for *Smart Learning Environments* and delivered the keynote address at the *International Conference of Innovative Technologies and Learning*.

FAWWAZ ULABY, the Emmett Leith Distinguished University Professor of Electrical Engineering and Computer Science and Arthur F. Thurnau Professor, was honored by The IEEE GRS Society, which changed the name of its highest award from the Distinguished Achievement Award to the "Fawwaz Ulaby IEEE GRSS Distinguished Achievement Award." Prof. Ulaby also served as founding Editor-in-Chief for the *IEEE Remote Sensing Code Library.*

WESTLEY WEIMER received the Computing Research Association – Education Undergraduate Research Faculty Mentoring Award. He and his coauthors received the Ten-Year Most Influential Paper Award from the *International Conference on Software Engineering* for "Automatically Finding Patches Using Genetic Programming," originally published in 2009.

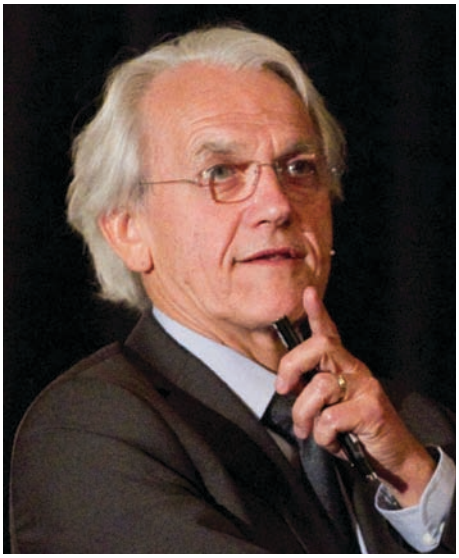
THOMAS WENISCH served as Associate Editor-in-Chief for *IEEE Computer Architecture Letters.*

JENNA WIENS delivered the keynote address at the *2018 MILETS Workshop*.

ZHENGYA ZHANG received the Neil Van Eenam Memorial Undergraduate Teaching Award from the College of Engineering.

Gérard Mourou Brings the Nobel Prize in Physics to the EECS Department

The Nobel Prize in Physics is awarded for outstanding contributions for mankind in the field of Physics.



Gérard Mourou, the A.D. Moore Distinguished University Professor Emeritus of Electrical Engineering and Computer Science, is one of three winners of the 2018 Nobel Prize in Physics for "groundbreaking inventions in the field of laser physics." He shares half of the prize with his former graduate student Donna Strickland, now an associate professor at the University of Waterloo in Canada. The other half of the prize went to former Bell Laboratories scientist Arthur Ashkin.

Mourou and Strickland were chosen for inventing "chirped pulse amplification (CPA)," a technique that has revolutionized the field of optics and led to advances in science, engineering, and medicine. Mourou developed the technique here at U-M where he taught for 16 years before retiring in 2004.

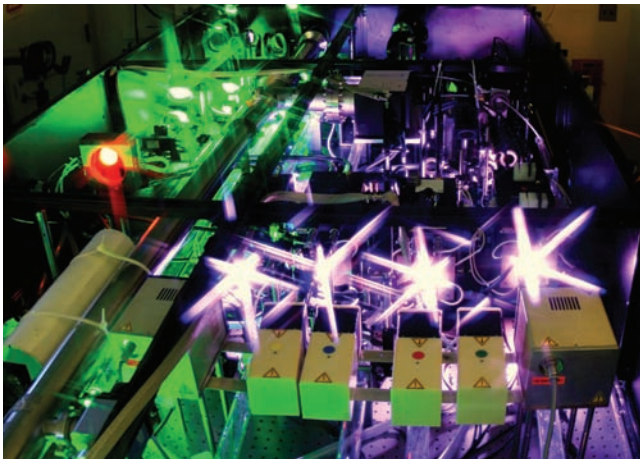
In 1991, he founded U-M's Center for Ultrafast Optical Science where the safer, bladeless version of LASIK eye surgery was developed using CPA and HERCULES, the world's most intense laser, was born.

Mourou returned to campus in February where he had lunch with students and presented a lecture to the general public about his work and the experience of winning a Nobel Prize. Alec Gallimore, the Robert J. Vlasic Dean of Engineering, Herbert Winful, the Arthur F. Thurnau Professor of EECS, and Prof. Louise Willingale all spoke at the presentation about Mourou's legacy and work.

Winful, a close friend of Mourou's, presented a proclamation from Gov. Gretchen Whitmer officially naming February 28 as "Chirped Pulse Amplification Day in Michigan." In addition, Michigan Engineering will rename CUOS the "Gérard Mourou Center for Ultrafast Optical Science."

"Extreme light is capable of generating the largest field, largest acceleration, largest temperature and largest pressure," Mourou said. "In the spirit of Alfred Nobel, it carries the best hope and opportunity for the future of science and society."

Winful was one of the few invited guests to the Nobel Prize ceremony. Winful remarked that while the food and setting were impressive, nothing was more meaningful to him than watching his friend be presented the Nobel Medal and diploma by the King of Sweden.



HERCULES, the most intense laser in the world, was built by Mourou during his time at U-M.

Gérard Mourou and Herb Winful holding the proclamation from Gov. Gretchen Whitmer proclaiming February 28 as "Chirped Pulse Amplification Day."

Leadership Service as Conference/Symposium/Workshop Chairs

IEEE MTT-S International Microwave Workshop on Advanced Materials and Processes

July 16-18, 2018, Ann Arbor, Michigan

General Co-chairs: Amir Mortazawi; Raafat Mansour (University of Waterloo, ON, Canada)

The purpose of *IMWS-AMP 2018* is to boost technical and educational activities as well as exchanges and collaborations within the international microwave community. It's organized by the IEEE Microwave Theory and Techniques Society (MTT-S) with the technical co-sponsorship of the European Microwave Association (EuMA).

IEEE International Symposium on Low Power Electronic Design (ISLPED)

July 23-25, 2018, Bellevue, Washington

General Co-chair: Thomas Wenisch

The *International Symposium on Low Power Electronics and Design (ISLPED)* is the premier forum for presentation of innovative research in all aspects of low power electronics and design, ranging from process technologies and analog/digital circuits, simulation and synthesis tools, system-level design and optimization, to system software and applications.

IEEE SENSORS Conference

October 28-31, 2018, New Delhi, India

General Co-chairs: Yogesh Gianchandani; Anil Roy (DA-IICT, India)

The flagship *International Conference of the IEEE Sensors Council* is intended to provide a forum for research scientists, engineers, and practitioners throughout the world to present their latest research findings, ideas, and applications in the area of sensors and sensing technology.

2nd Symposium on Simplicity in Algorithms

January 6-9, 2019, San Diego, CA

Conference Organizer: Seth Pettie

The Symposium on Simplicity in Algorithms (SOSA) welcomes papers that advance simplicity and elegance in both the design and analysis of algorithms.

International Symposium on Performance Analysis of Software and Systems (ISPASS)

March 24-26, 2019, Madison, Wisconsin

General Chair: Thomas Wenisch

The objective of the *IEEE International Symposium on Systems and Software (ISPASS)* is to provide a platform for sharing proven research on performance analysis in the areas of systems and software.

22nd ACM International Conference on Hybrid Systems: Computation and Control (HSCC 2019)

April 16-18, 2019, Montreal, Canada

General Co-chairs: Necmiye Ozay and Pavithra Prabhakar (Kansas State University)

HSCC is dedicated to advancing design and analysis techniques that bridge control theory and computer science, and is expanding to new domains in security and privacy and in systems biology.

International Conference for Advanced Neurotechnology

May 19-21, 2019, Korea Institute of Science and Technology, Seoul, Korea

General Chair: Euisik Yoon

ICAN brings engineers and neuroscientists together to review recent advancements in neurotechnology and neuroscience, define the need for next-generation tools to move neuroscience forward, and enhance translation of technology to the science-community.

Bertinoro Workshop on Fine-Grained Approximation Algorithms and Complexity

May 27-31, 2019, Bertinori, Italy

Workshop Organizer: Seth Pettie

This workshop will focus on the intersection of Fine-Grained Complexity and Approximation Algorithms/Hardness of Approximation, that is, on the concrete (polynomial-time) complexity of approximation algorithms.

Leadership Service as Conference/Symposium/Workshop Chairs

The Multi-disciplinary Conference on Reinforcement Learning and Decision Making (RLDM 2019)

July 7-10, 2019, Montreal, Canada

General Chair: Satinder Singh Baveja

This conference brings together researchers spanning a wide variety of fields including psychology, artificial intelligence, machine learning, operations research, control theory, animal and human neuroscience, economics, and ethology

International Symposium on Information Theory

July 7-12, 2019, Paris, France

General Co-chairs: Alfred Hero; Pablo Piantanida (CentraleSupélec, France)

Hosted by the *IEEE Information Theory Society, ISIT* is the premier international conference dedicated to the advancement of information theory and related areas.

Genetic Improvement of Software 2019

July 13-17, 2019, Montreal, Canada

Conference Organizer: Westley Weimer

Genetic Improvement is the application of evolutionary and search-based optimization methods to the improvement of existing software. The workshop offers an opportunity for researchers to disseminate work, but most importantly to meet and discuss with other GI researchers.

Fundamental Optical Processes in Semiconductors

August 4-9, 2019, Banff, Canada

General Co-chairs: Mackillo Kira; Xiaodong Xu (University of Washington)

Fundamental Optical Processes in Semiconductors (FOPS) encompass enabling technologies for future-generation devices; advances in technology, materials growth, measurement techniques and understanding of quantum-optical/many-body phenomena continue to stimulate great activity in the field. The topics of the conference constantly evolve to reflect the most recent developments of optical and condensed matter physics.

Machine Learning for Healthcare

August 16-18, 2019, Ann Arbor, Michigan

General Chair: Jenna Wiens

MLHC is an annual research meeting that exists to bring together two usually insular disciplines: computer scientists with artificial intelligence, machine learning, and big data expertise, and clinicians/medical researchers. MLHC supports the advancement of data analytics, knowledge discovery, and meaningful use of complex medical data.

National Academies Decadal Survey of Plasma Physics

Fall 2019 - Winter 2020

Committee Co-chairs: Mark Kushner; Gary Zank (University of Alabama)

This assessment occurs once every ten years and examines the progress of plasma physics in the U.S. and internationally, as well as the priorities for the next 10 years. This report is sponsored by the Department of Energy, the National Science Foundation, and the Department of Defense.

Appointments

Forrest Co-chairs U-M's Commission on Carbon Neutrality

As co-chair of U-M's newly-formed Commission on Carbon Neutrality, Prof. Forrest will help lead a team of experts that will explore how all three U-M campuses (Ann Arbor, Flint, Dearborn) can achieve a net zero carbon footprint in an economically feasible way and within a reasonable timeline. The 17 members of the Commission will look at carbon emissions and sequestration; energy sourcing; technology development and policy change; facilities, operations and mobility; and behavioral change. "We want to become a model for others," said Prof. Forrest, who is a world-renowned pioneer in the field of renewable energy. "Our responsibility is to the University of Michigan, but a vast amount of the world population lives in small cities just like ours. What we do may not work for everybody, but it'll create pathways that other people can follow, and – together – that will have a global impact."

Jagadish is New Michigan Institute for Data Science Director

Since February 15, 2019, Bernard A. Galler Collegiate Professor of Electrical Engineering and Computer Science has served as the new director of MIDAS. Jagadish replaces MIDAS Co-directors Brian Athey and Alfred Hero. "Prof. Jagadish is a leader in the field of data science, and over the past two decades, he has exhibited national and international leadership in this area," said S. Jack Hu, vice president for research. "His leadership will help continue the advancement of data science methodologies and the application of data science in research in all disciplines." As director, Jagadish aims to expand the institute's research focus and strengthen its partnerships with industry. "The number of academic fields taking advantage of data science techniques and tools has been growing dramatically," Jagadish said. "Over the next several years, MIDAS will continue to leverage the university's strengths in data science methodologies to advance research in a wide array of fields, including the humanities and social sciences."

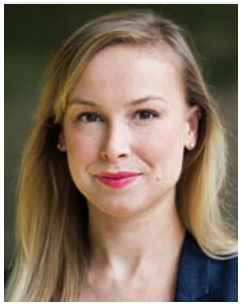
Halderman Co-chairs Commission to Protect Michigan Votes

Prof. J. Alex Halderman is co-chair of the newly-formed Michigan Election Security Commission, which was established by Secretary of State Jocelyn Benson. Halderman, whose work in election security and in exposing the vulnerabilities of electronic voting machines is considered a preeminent expert in the field.

"This first-of-its-kind effort brings together 18 local and national experts on cybersecurity and elections to secure elections and protect the integrity of every vote," the Secretary of State office said in a release.

Halderman has made multiple contributions to election security advocacy at the federal level. Since 2017, he's testified before both the Senate Intelligence Committee and U.S. House Appropriations Subcommittee on Financial Service and General Government to address vulnerabilities in the U.S. voting system and a policy agenda for securing the system against the threat of hacking. The commission held its first meeting on April 16, 2019 in the Bob and Betty Beyster Building, home of the CSE division.

Wiens Named New Precision Health Co-director



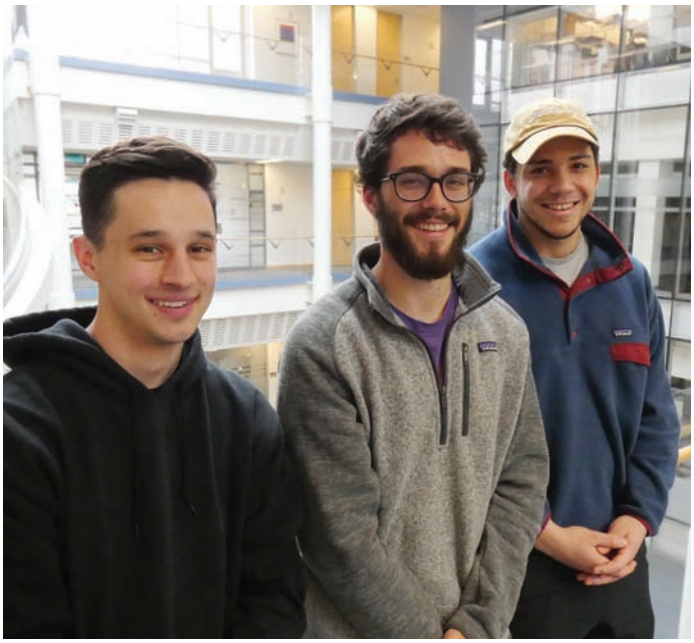
Effective September 1, 2019, Prof. Jenna Wiens became a Precision Health Co-director. Weins succeeds Eric Michielssen of EECS, who is stepping down as Co-director to take sabbatical leave.

Wiens transitioned to Co-director from a successful role as a Co-lead for Precision Health's Data Analytics & IT Workgroup, which expanded access to data and research tools across the university with their launch of the Precision Health Analytics Platform.

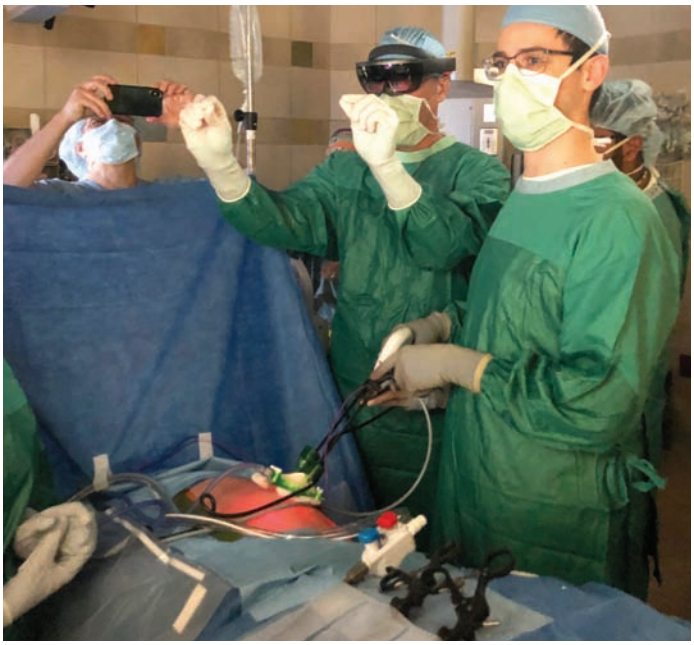
"As Co-lead for the Data Analytics & IT Workgroup, I worked hard to improve 'data liquidity' across campus, by facilitating access to secure HIPAA-aligned compute environments," Wiens said. "This infrastructure will make it easier for researchers across schools and colleges to work together on health data and promises to accelerate interdisciplinary collaborations at U-M."

Wiens possesses a strong track record in precision health research, particularly her work developing hospital-specific machine learning models to predict the spread and severity of Clostridium difficile infection among patients.

STUDENT NEWS



CS students Mitchell Bigland, Nicholas Keuning, and Chase Austin.



Armed with an augmented reality headset, a surgeon browses an app designed by three CS students to view the interior of a patient during an operation.

Student Team Brings Augmented Reality to the Operating Room

Three CS students and alumni have launched operating room monitors and screens into the virtual world of augmented reality. Mitchell Bigland (BS CS 2019), Nicholas Keuning (BS CS 2018), and Chase Austin (BS CS expected Fall 2019), working with Dr. David Chesney and Dr. Marcus Jarboe of Pediatric Surgery, have developed an app for the Microsoft Hololens to stream a video feed of a patient's internals directly to the surgeon's field of vision, helping them keep their eyes on their tools.

Keeping surgeries minimally invasive has many benefits for a patient – smaller scars, less time in the operating room, faster recovery, and fewer pre-operation jitters among them. A procedure called laparoscopy has become a powerful way for doctors to stick to smaller cuts in a number of common surgeries.

The procedure takes its name from the laparoscope, a slim video camera and light that can fit into small incisions and give surgeons an internal view of the patient. When inserted, doctors watch a video monitor in the operating room to see what's happening. Without those tools, they'd have to make a much larger opening.

But the use of monitors poses some challenges to surgeons and nurses. While keeping procedures more comfortable for patients, it leaves surgeons multitasking and looking from the monitor back to the tools as they maneuver with the camera. On top of that, the screens tend to clutter the operating room and can be difficult to position in the doctor's field of view.

"The doctors told us that it can be hard to see," Keuning explains. "At times they require assistance from nurses to point things out on the screen."

So the team took the feed from the surgeon's laparascope and streamed it with a Hololens, where it's always in the user's frame of view and easy to reposition or resize with gestures and voice control.

"That will maximize the amount of time they can spend actually looking at the patient," says Bigland, "and, we believe, improve how well they can see the actual video."

The app's other main feature is a scan gallery that gives doctors the ability to load images of previous diagnostic scans, such as CAT scans or MRIs, and arrange them alongside the video stream. Users can manipulate the position and size of the scans, as well as alter their brightness and contrast in real time.

The project originated in Fall 2018 in Chesney's EECS 495 course, Software Development for Accessibility, which connects students with hospital clients looking for software solutions to particular issues in their field. It was there that the team met Jarboe, all submitting similar proposals after he described his difficulties in the operating room to the class. The trio opted to continue development with him in the Winter semester, ultimately bringing a fully functioning prototype to a live procedure in May.

"Dr. Chesney was very good at bringing together enough pieces that you could then turn it into a real opportunity for a concrete project," says Keuning.

Ashley Gee (lower left), an undergrad in electrical engineering, helps install solar panels on a house in Long Beach, CA.

Camille Burke, an undergrad in electrical engineering, helps install solar panels in Nepal.

Building Community Through Clean Energy With GRID Alternatives

This past spring, U-M student group GRID Alternatives sent students to Long Beach, CA and Nepal to install solar panels to provide clean, affordable energy to homes and communities.

In Long Beach, CA, electrical engineering undergrad Ashley Gee worked with underserved and underprivileged communities and helped install solar panels on family homes. For Gee, one of the most impactful parts of the trip was learning about other ways GRID and the clean energy industry is working to improve lives. They partner with organizations that help rehabilitate former gang members, and they ensure that every community is equipped with the necessary resources and support before and after the project is complete.

In Nepal, electrical engineering undergrad Camille Burke helped convert an old watchtower that was completely devoid of power into a fully-powered wildlife-observation center that could house people overnight. The watchtower was in the heart of Chitwan National Park, a world heritage site.

For Burke, nothing was more powerful than being welcomed into a place that was so very different from everything she knew. The entire Nepalese community came to greet Burke's group when they arrived. The community members sang, clapped, and gave each of the students a traditional garland of brilliant orange marigolds as a welcome.

"It was so beautiful," Burke says. "On both sides, we wanted to make each other feel as safe and happy and comfortable as possible. We couldn't really speak to each other, yet we felt very welcome and they felt very loved by us. You don't need language to show that."

Baja Racing Wins World Championship With All-Time Record

It is not a sport for the faint of heart.

Baja Racing is an off-road motocross race that tests the limits of your endurance and skill as a driver. Every year, collegiate teams from around the world build their own Baja racecar, which then compete in three competitions where they are judged on multiple criteria from design presentations and cost audits to hardcore suspension tests and a 4-hour long endurance race. The top team that competes in all three competitions is awarded the Mike Schmidt Memorial Iron Team Award, which is equivalent to a world champion title.

This year, the Michigan Baja Racing team – which features two electrical engineering students – not only took 1st place for the Mike Schmidt Memorial Iron Team Award, but they did so while breaking the all-time record for cumulative high score since the award began in 2001.

Max Baer, a junior in EE, joined the team last year and attributes the success to the team's inclusive and positive environment.

"On Baja, all the upperclassmen encourage and support underclassman," Baer says. "No matter your class standing, knowledge of cars, or ability to turn a wrench, there is always meaningful work to be done on our cars."

Hacking the Perfect Melody

Project Music celebrates the conclusion of the first Music Makeathon.

Designing the winning project: the bass guitar triggered sampler.

Project Music brought together students from all backgrounds across the university to originate musically-inspired creations for the first Music Makeathon.

Over 18 hours, students were challenged to design their own music-related project. The first-place project was a bass guitar triggered sampler. It analyzed whatever sound was input to find all the samples within a song, and then it would play the sample that most resembled what the instrument played.

Team Space Knobs built a vocal harmonizer that would harmonize with any sound input. Team Big Sound designed an instrument based on a turntable that would play percussively over a sensor and different distances, which would change the note of the instrument.

The twelve participating students came from many departments across the university. The teams competed for a variety of prizes, and the judges were professionals in the audio industry, which gave the students a taste of the kinds of projects that might succeed in the professional world.

“There’s a lot to say about the crossover between technology and the arts,” Sophia Mehdizadeh, an Audio Engineer in Advanced Development at Mitsubishi and former Project Music member who helped judge the event, said. “When you do something interdisciplinary like Music Makeathon where you get a lot of different perspectives, really great things come out of projects.

Michigan Mars Rover Team Has Best Ever Finish at the Annual University Rover Challenge

The Michigan Mars Rover Team celebrates their best ever finish at the University Rover Challenge held in Utah.

MRover placed 7th overall and 4th in the U.S. at the annual challenge where rovers use AI to navigate tough terrain while collecting soil samples to practice testing for evidence of life in the universe. They also received a perfect score in the science task.

The University Rover Challenge (URC) is hosted by The Mars Society, the largest advocacy group for the exploration and settlement of Mars. Only 36 teams can compete in the URC. The goal of the competition is to help further the design and operation of rovers to help future astronauts explore new worlds.

“A lot of the people who are in our organization now are learning the skill sets that’ll help them be on the front foot of the space exploration field,” says Michelle Gehner, a sophomore in EE who will serve as president of MRover this coming year.

MRover is highly interdisciplinary involving students from all over the university, but while the diversity of expertise is important to MRover, they have also committed to ensuring a diversity of personnel. Forty percent of members are women, and the incoming executive board is eighty percent women.

“It’s a fact that women are underrepresented within the field,” Gehner says, “but that tide is changing. I’m really proud of the culture of our organization.”

Team Aquador

Katherine Lastoskie and Deanna Hanley, electrical engineering students who made up the Energy Team for Team Aquador, traveled to Ecuador with the Team to conduct detailed water testing in Olmedo. Their goal is to implement a water purifying solution that is easy to use and maintain by local communities, and this is their second trip to the town.

According to Lastoskie, Energy Team Lead, they held a town-hall meeting with regional government officials and participated in both radio and televised interviews to publicize the project to the entire region. They also worked closely with mayor Klever Sanchez to arrange travel to rural communities. Team Aquador conducted video interviews and took photos and measurements of existing water treatment systems in Ecuador with the goal of improving their water purifying prototype later this year.

“These experiences have allowed us to apply the skills that we learn in our EE courses to a project that we are passionate about,” said Lastoskie. For example, the Energy Team used solar panels and other energy sources for the water purification/filtration system. “Our understanding of circuit components, particularly electronic ballasts has already been useful in selecting a UV bulb for one of the purification stages of our system,” she added.

HKN Receives Outstanding Chapter Award

This award is presented to IEEE-HKN Chapters nationwide in recognition of excellence in their Chapter administration and programs. The University of Michigan Beta Epsilon Chapter of HKN is a regular recipient of the award. Their regular service activities include: tutoring, Scouts Day, helping out at Sequoia Place (a retirement center), restoration at Nichols Arboretum and Matthei Botanical Gardens, and participating in Detroit Partnership Day.

MRacing

Competition(s): Formula Lincoln, Formula North, Formula Michigan

Purpose: MRacing is U-M’s Formula SAE team where students use technical innovation and advanced engineering analysis to build formula-style racecars and compete in a collegiate motorsport racing series.

Place: 2nd overall (Lincoln); 2nd overall (North); 4th overall (Michigan)

Finished 1st in acceleration at all events

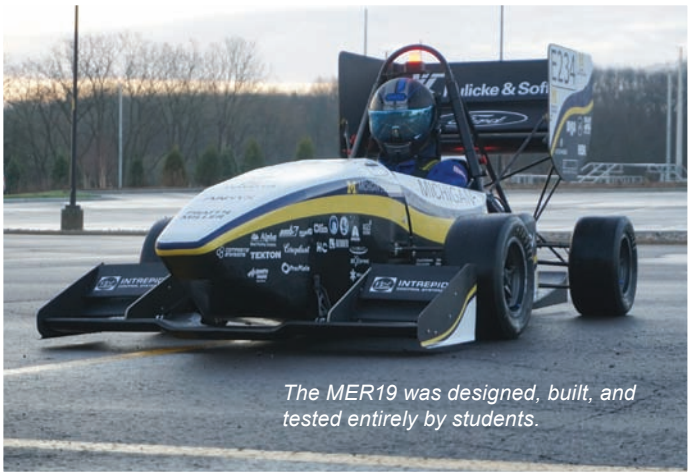
Strength Augmenting Robotic Exoskeletons (STARX)

Competition: Applied Collegiate Exoskeleton (ACE)

Purpose: Demonstrate the abilities of their powered mechanical suits, which are designed to help emergency responders lift heavy items and experience less physical strain.

Place: 1st

Michigan Electric Racing



The MER19 was designed, built, and tested entirely by students.

Competitions: Formula North and FSAE Electric in Lincoln, Nebraska

Purpose: MER designs, builds, tests, and finances their own high-performance, full-electric Formula-style race car. This was the team's first year competing with a full-electric vehicle (they were formally MHybrid). They transitioned to full-electric as a response to overall trends in the automotive industry.

Place(s): 2nd (Formula North); 9th (FSAE Electric)

Compact Localized Augmented Work-Station

Competition: NASA SUITS Challenge

Purpose: A competition to develop an Augmented Reality (AR) user interface to assist astronauts during EVAs. The U-M's Compact Localized Augmented Work-Station (CLAWS) team is a subgroup of the Students for the Exploration and Development of Space (SEDS) organization and whose proposal was accepted by the NASA committee to develop this AR system and test it at the Johnson Space Center (JSC) in April.

UM::Autonomy

Competition: Association for Unmanned Vehicle Systems International Foundation Roboboat competition

Purpose: To further the study of autonomous robotics.

Place: 1st in static judging

MFly

Competition: SAE Aero Design competition (Regular-Class)

Purpose: To design, build, test, and fly two radio-controlled airplanes. Regular-Class is a payload lifting competition.

Place: 6th

The Optics Society Building Community

Front (l-r): Grace Kerber, Hannah Kim; Back (l-r): Kaiwen Guo, Laura Andre.

Students, faculty, industry representatives, and community members came out for the event.

Andre leading a club session at the Peace Neighborhood Center. The lesson of the day was how to make a camera.

This year, nearly 100 students, faculty, industry representatives, and local community members turned out for the *Optics and Photonics Industry Spotlight*. The event is organized by the Optics Society at the University of Michigan (OSUM) in partnership with the Ann Arbor Chapter of the Optical Society. The goal of the event is to celebrate the field of optics and photonics and give attendees a chance to network.

This year's keynote speaker was Dr. Marc D. Himel, the Director of Inside Sales and Customer Success at MKS Instruments – Newport Corporation. He spoke about the impact of optics and photonics on the world today and how optics will serve the greatest engineering challenges of the future. In addition to the presentation, the event included a career fair, where companies from all over the State of Michigan came to present their work and host informational tables.

Laura Andre, an ECE PhD student, serves as president of OSUM and helped organize the event.

"I hope that the audience was able to get a sense of all of the different ways that optics influences science, technology, and our daily lives," Andre said. "Students hopefully have a better idea of the opportunities available to them after graduation in the field of optics and are confident that the future of the field is bright."

Andre also helped organize a new project in partnership with the Peace Neighborhood Center, a community organization that provides programs and services to those who are affected by social and economic problems. Every week in the Winter 2019 semester, a member of OSUM and volunteers from the Ann Arbor Section of the Optical Society of America host an after-school club to teach kids about optics, as well as science and engineering. They bring recycled consumer electronics – such as old point-and-shoot cameras – and have the students dissemble the items to learn about the different components and subsystems, and then use the scrap parts to build something new.

"I really enjoy helping to form a closer-knit community," Andre says.

Amateur Radio Continues to Connect the World

The UMARC features powerful radios and tech that can connect people from all over the world.

The "Little Brown Jug" is the oldest trophy in college football history. Photo courtesy of the Bentley Historical Library.

Prof. Tony England served on the Space Shuttle Challenger. Photo courtesy of NASA.

Amateur radio or "ham radio" has been connecting people from all over the world for more than a century. The University of Michigan Amateur Radio Club (UMARC) was founded in 1913, and it has borne witness to several important historical moments. However, one of the station's most famous contributions to the university itself happened before the club was even formed.

In 1903, Floyd "Jack" Mattice – a U-M student and ham radio operator – telegraphed the events of the historic October 31 away football game between Michigan and Minnesota, where a reportedly suspicious Fielding Yost brought a five-gallon jug to ensure clean water for his team. Yost accidentally left the jug behind, but when he asked for it to be sent to him, he was told that if he wanted it, his team would have to win it back. The competition for the "Little Brown Jug," the oldest "trophy" in college football history, was born, along with one of the earliest instances of sports broadcasting.

Today, despite cell phones and the internet, there are still many relevant applications for amateur radio.

"During natural disasters, we may lose electricity for a prolonged period of time, or we may lose cellphone towers, and then the ability to communicate is disrupted," says John Palmisano, a station manager for W8UM. "With amateur radio, our transceivers can be operated using a car battery or solar cells, and as long as we can suspend two wires in a tree, we can often make a radio contact."

In addition to the practical uses, members say ham radio is appealing because it's fun. You never know who you might make contact with. They could be on the other side of the world – or they could be orbiting it.

Tony England, the Dean of the College of Engineering and Computer Science at U-M Dearborn and Professor of ECE, is a member of the club and a former NASA astronaut. He was flying a mission on the Space Shuttle Challenger in 1985 when he picked up a call on his amateur radio. The caller was someone with a walkie-talkie who, like most ham radio operators, was just hoping to make a new contact.

"This is W0ORE in Space Shuttle Challenger," England replied. "How are you today?"

EECS SWE Members Turn Out Strong at Conference

EECS members of the U-M Society of Women Engineers.

With financial support from the Department, the Society of Women Engineers (SWE) took 10 EECS students to the *Women Engineers Conference*, where engineers from diverse backgrounds shared their stories to inspire and encourage young engineers to break barriers and advance the field.

"By standing in front of us and sharing their successes as well as their failures, they communicated to us that the world is ours; we can be leaders, engineers, world travelers, adventurers, as well as mothers and wives, if we so choose," said Gillian Minnehan, a sophomore in Computer Engineering. "I have always been inspired and encouraged by women who have gone over the career and life hurdles that I am currently experiencing or will eventually experience, and these women were no exception."

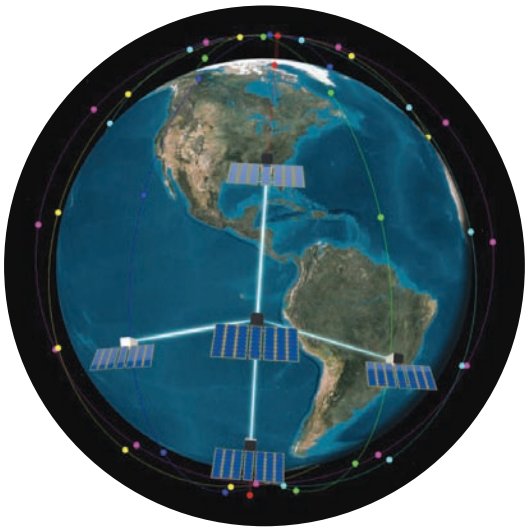
Miniature Satellites for Max Communication

Havel Liu, a CE and ME undergraduate student, is part of a team that hopes to revolutionize how satellites operate, allowing for near-instant communication all over the globe. They plan to send a system of tiny networked satellites into orbit that will cover 99.7% of the world. Messages could then be passed through the constellation of satellites to anywhere in the world. The main goal of this project is to improve communication during natural disasters, particularly in remote areas where signals are weakest.

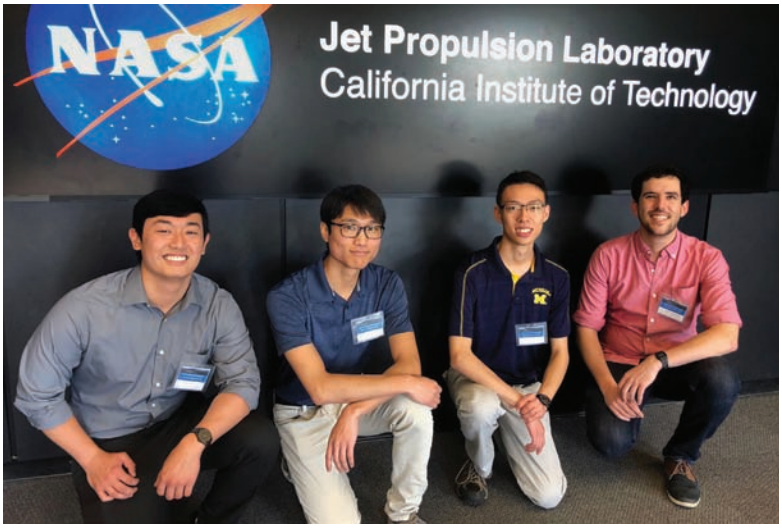
If the project is successful, it could not only change our Earthly system of communication, but it could also guide the design of future interplanetary communication arrays.

“Say we have a colony on Mars – you could have a similar satellite swarm surrounding Mars,” Liu says. “Then you could actually pass messages back and forth to colonists and astronauts when they have stronger radios and antennas.”

Liu’s project is called the “Distributed Universal Satellite Technology (DUST).” It’s done through the Sensor Network Laboratory and is part of the College of Engineering’s opportunities for students across the university every year. Liu’s project is funded by NASA’s Jet Propulsion Laboratory (JPL).



66 CubeSats would surround the globe and communicate with one another.



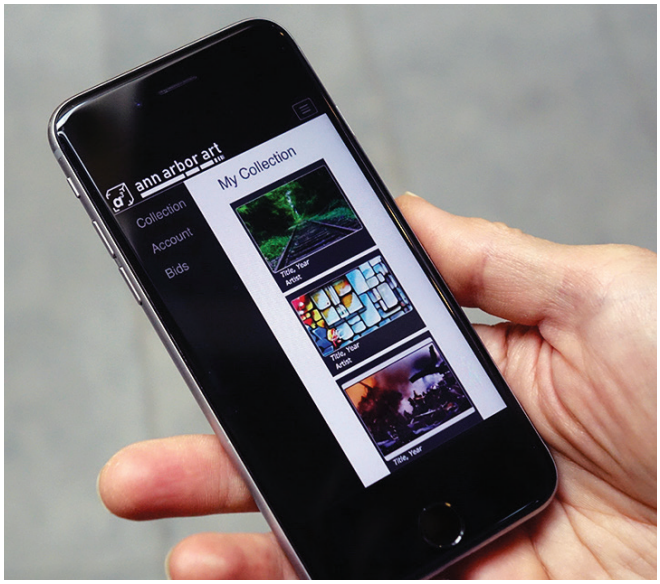
From left: Havel Liu (BSE CE ME) and teammates Taylor Sun (BSE ME), Jeff Yin (BSE CE), and Andres Penaranda (MSE AERO) present at the JPL poster conference.

Students Map Ann Arbor Art

Students in Dr. Jeff Ringenberg’s Major Design Projects senior capstone class in computer science are working to make the massive Ann Arbor art scene easily accessible for everyone. The Ann Arbor Art Alliance (or A^3) recruited a group of five CSE students in Ringenberg’s class to spend their semester developing a fully functional app to locate not only existing art in town, but offerings in a rotating art gallery the group is proposing.

Diego Rojas Salvador was one of those students. Currently a Master’s student in CSE, he says, “The key point was to develop a tool to allow anyone to explore the Ann Arbor art scene through our app. Art was the focus, but this project was very much about location and getting more connected. We focused on a map-based approach in which the user could map spaces where art could be found. The goal of the app was also to create a platform for bidding on and purchasing art displayed if it was for sale.”

The goal of A^3 is to create visibility and opportunity for local artists and art lovers. This app is a by-product of their plan to create a rotating public art gallery, displaying the work of local artists who would be selected via juried competitions. Winners would get the opportunity for a four-month show all over Ann Arbor. The app would be central to the plan, and Ringenberg’s students delivered an app just about ready for beta testing in the span of one semester.



The winning team with program judges and organizers. L: Prof. David Brophy, Jonathan Fay, Prof. Mingyan Liu, Bryce Pilz, Avish Kosari, Joseph Heanue, Dr. Armin Jam, Rick Bolander, Prof. Khalil Najafi.

SkyGig Startup Wins Inaugural ECE Innovator Program

SkyGig, a startup company focused on improving wireless communication in the world of 5G and beyond, is the inaugural winner of the ECE Innovator Program, launched in 2018. Co-founded by Avish Kosari and alumnus Dr. Armin Jam (MS PHD EE 2013 2017), they are leveraging over a decade of research in the area of wireless radios to bring a disruptive technology to the marketplace. Their unique wireless technology platform paves the path for the next generation of high-speed wireless communication devices, where the team plans to work with tele-communication giants to find the best network solutions.

"With the emergence of autonomous cars, Internet of Things devices, smart city applications, etc., there is more need than ever for innovative communication devices to enable all these applications, and that is exactly what we do," said Jam.

SkyGig is one of nine teams that participated in the Electrical and Computer Engineering Innovator Program. The remaining eight teams are working on technology impacting patient care and health, communications, ultra-accurate navigation for autonomous systems, artificial intelligence for the energy sector, information security, powering Internet of Things devices, and next-generation flexible electronics.

There were three finalists in all; the other two teams featured flexible display technology, and miniature-sized, autonomous, vibration energy harvesters with record power efficiency. Team members of the display tech, which has already been licensed to a startup company for commercialization, include doctoral students Yongbum Park and Chengang Ji, and their advisor Prof. Jay Guo. The energy harvesting tech was presented by ECE alumnus Dr. Ethan Erkan Aktakka, founder of the startup ActiveMEMS. ActiveMEMS sees smart manufacturing and transportation sectors as its key markets.

Dr. Jae Yoong Cho, co-founder and CEO of Enertia Microsystems and another ECE alum, took the opportunity to present his technology, consisting of small precision affordable rotation sensors for pinpoint accuracy in autonomous devices, such as vehicles and drones.

"With the emergence of autonomous cars, Internet of Things devices, smart city applications, etc., there is more need than ever for innovative communication devices to enable all these applications, and that is exactly what we do," said Jam.

All presenting teams were invited to participate in Prof. David Brophy's popular and over-subscribed business course, Financing Research Commercialization, in which entrepreneurial teams work with mentors to build a business and marketing plan for a new technology or invention.

University and National Individual Honors and Awards

Navid Barani (ECE graduate student) received the IEEE APS Doctoral Research Award for his work modeling how bacteria use electromagnetic waves to communicate.

Laura Burdick (CSE graduate student) received a Rackham Outstanding GSI Award for innovative work as educator and promoting diversity.

Qi Alfred Chen (MS PhD CSE 2014 2018) received a ProQuest Distinguished Dissertation award from the Rackham Graduate School for his dissertation, “Securing Smart, Connected Systems Through Systematic Problem Analysis and Mitigation.”

Glen Chou (ECE graduate student) received a National Defense Science and Engineering Graduate Fellowship (NDSEG) Fellowship to support his research focused on improving the safety of autonomous systems.

Charles Eckert (CSE graduate student) received an NDSEG Fellowship to support his research to overcome Moore’s Law with innovative architecture.

Michelle Gehner (EE undergraduate student) was awarded an IEEE Power and Energy Society scholarship for her excellent academic record and her work in the power and energy field.

Huanting Huang (ECE graduate student) won the Best Student Paper Award at the *IEEE International Conference on Computational Electromagnetics* for her work developing better mathematical models that estimate tree and vegetation cover.

Hiwot Kassa (CSE graduate student) received a Microsoft Fellowship for research in a new computing paradigm.

Milad Zolfagharloo Koohi (ECE graduate student) received an IEEE Microwave Theory and Techniques Society Graduate Fellowship for his work on agile radio frequency (RF) technologies that enable 5G and beyond.

Allison McDonald (CSE graduate student) received a Facebook Fellowship for research on web privacy, security, and censorship.

Md Salman Nazir (ECE graduate student) received an Outstanding Reviewer recognition by the IEEE Transactions on Power Systems for his outstanding reviews of recent papers.

Samir Nooshabadi (ECE undergraduate student) received fellowships from the Department of Defense and the IEEE Microwave Theory and Techniques Society to pursue research in developing a high-data rate communications system based on a high-power terahertz source.

Hanzhang Pei (ECE graduate student) was awarded a 2019 Optics and Photonics Education Scholarship by SPIE, the International Society for Optics and Photonics, for his potential contributions to the field of optics, photonics, or related field.

Matt Perez (CSE graduate student) received an NSF Graduate Research Fellowship for automating speech-based disease classification.

Brandon Russell (ECE graduate student) received a Rackham International Student Fellowship award to support his research on magnetic fields in high-energy plasmas, which could help advance the development of clean energy and our understanding of energetic astrophysical phenomena.

Arun Subramaniyan (CSE graduate student) received a U-M 2018 Precision Health Scholars Award for his work on hardware accelerators for faster gene sequencing analysis.

Jie-Fang Zhang (ECE graduate student) was awarded the Chia-Lun Lo Fellowship for his work designing hardware solutions that could help support computer vision and machine learning.

Anthony Zheng (CS undergraduate student) is one of ten nationwide recipients of the Ford Alan Mulally Scholarship in Engineering.

Zeyu Zheng (CSE graduate student) received a Rackham International Student Fellowship for enabling autonomous agents to learn continuously.

EECS Awards

Undergraduate

Outstanding Achievement Award
Guyi Chen (CS)
Matthew Kramer (EE)
Nathan Riopelle (CE)

William L. Everitt Student Award of Excellence
Jingliang Ren (CE)
Ben Stoler (CS)
Michelle Yi (EE)

Outstanding Research Award
Cheng Jiang (CS)
Samir Nooshabadi (EE)
Haojie Ye (CE)

Outstanding Service Award
Joseph Costello (EE)
Trevor Gullstad (CS)
Joshua Knebel (CE)

William Harvey Seeley Prize
Cameron Kabacinski (EE)

Commercialization/Entrepreneurship
Yara El-Tawil (CS)
Nathan Houghteling (EE)
Kevin Kulat (CE)

Richard K. Brown Memorial Scholarship
Katherine Banas (EE)

College of Engineering Awards

Undergraduate

Arlen R. Hellwarth Award
Stefany Escobedo (CE)
Serenity Monroe (EE)

Distinguished Academic Achievement Award
Rachel Menge (CE)
Steven Jecmen (CS)
Austin Xu (EE)

Distinguished Leadership Award
Isha Bhatt (EE)

Hugh G. Rumler Prize
Alex Wilf (CS)

Outstanding Instructional Aide for Winter 2019
Rachel Menge

Graduate

Richard F. and Eleanor A. Towner Prize for Distinguished Academic Achievement
Abraham Addisie
CSE PhD student
Advisor: Prof. Valeria Bertacco

Xin Zan
ECE PhD student
Advisor: Al-Thaddeus Avestruz

Richard and Eleanor Towner Prize for Outstanding PhD Research
John Gideon
CSE PhD student
Advisor: Prof. Emily Mower Provost

Mohammad Mahdi Khalili
ECE PhD student
Advisor: Prof. Mingyan Liu

Huanting Huang
ECE PhD student
Advisor: Prof. Leung Tsang

Richard F. and Eleanor A. Towner Prize for Outstanding Engineering GSIs
Nel Escher
CSE Master's student

Distinguished Leadership Award
Laura Andre
ECE PhD student

Helen Wu Award
Nooshin M. Estakhri
ECE PhD Student

Graduate Symposium Awards

Award for Scientific Visualization
Xin Zan
ECE PhD student
Advisor: Prof. Al-Thaddeus Avestruz
Demo title: *27.12 MHz Real-Time Smart-Controlled Bi-Directional Wireless Power Transfer with Current-Mode Class D Converters.*

Emerging Research, Engineering Innovation
Katie Matton
Advisor: Prof. Emily Mower Provost

Emerging Research, Science Communication
Matt Perez
Advisor: Prof. Emily Mower Provost

Emerging Research, Social Impact
Glen Chou (ECE PhD student)
Advisor: Prof. Necmiye Ozay
Poster title: *Using Control Synthesis to Generate Corner Cases: A Case Study on Autonomous Driving*

Graduate Student Instructor (GSI) Awards

Outstanding GSI for the Academic Year
Paul Domanico (ECE PhD student)

Outstanding GSI for Fall 2018
Milad Zolfagharloo Koohi (ECE PhD student)

Outstanding GSI for Winter 2019
Brian Raeker (ECE PhD student)

Congratulations to the following individuals who earned their Doctorate during the 2018–2019 academic year!

David Adrian, *Using Large-Scale Empirical Methods to Understand Fragile Cryptographic Ecosystems* (Prof. J. Alex Halderman, Chair), CSE

Fatemeh Akbar, *New Architectures for Low Complexity Scalable Phased Arrays* (Prof. Amir Mortazawi, Chair), EE

Seyed Mohammad Amjadi, *Electromagnetic Concepts to Enhance Communication in Harsh RF Environments* (Prof. Kamal Sarabandi, Chair), EE

Yujie An, *Efficient Algorithms for a Mesh-Connected Computer With Additional Global Bandwidth* (Prof. Quentin Stout, Chair), CSE

Alexander Benken, *A High-Yield Microfabrication Process for Sapphire Substrate Pressure Sensors With Low Parasitic Capacitances and 200 C Tolerance* (Prof. Yogesh Gianchandani, Chair), EE

Aniruddha Bhattacharya, *Properties of III-Nitride-Based Polariton and Spin Polariton Diode Lasers* (Prof. Pallab Bhattacharya, Chair), EE

Zelalem Birhanu Aweke, *Leveraging Processor Features for System Security* (Prof. Todd Austin, Chair), CSE

Mitchell Bloch, *Computationally Efficient Relational Reinforcement Learning* (Prof. John Laird, Chair), CSE

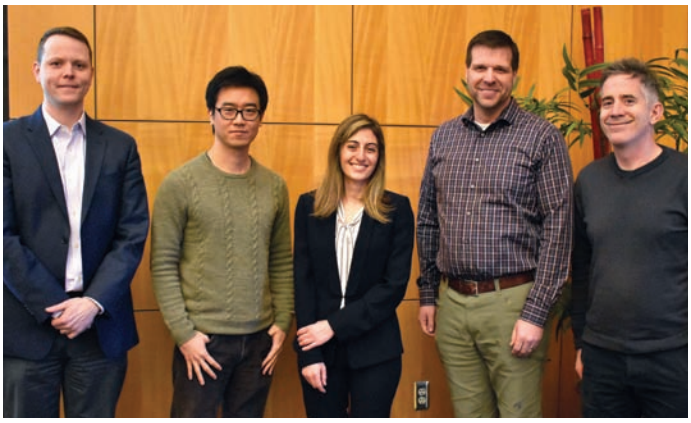
Quinn Burlingame, *Operational Stability and Charge Transport in Fullerene-Based Organic Solar Cells* (Stephen Forrest, Chair), EE

Fuxi Cai, *Neuromorphic Computing With Memristors: From Devices to Integrated Systems* (Prof. Wei Lu, Chair), EE

Yi-Jun Chang, *Locality of Distributed Graph Problems* (Prof. Seth Pettie, Chair), CSE

Yu-Wei Chao, *Visual Recognition and Synthesis of Human-Object Interactions* (Prof. Jie Deng, Chair), CSE

Qi Alfred Chen, *Securing Smart, Connected Systems Through Systematic Problem Analysis and Mitigation* (Prof. Z. Morley Mao, Chair), CSE



Yu-Heng Cheng, *High-Efficiency Microfluidics for Single Cell Phenotypic and Transcriptomic Analysis of Rare Cancer Cells* (Prof. Euisik Yoon, Chair), EE

Nikolaos Chiotellis, *Unconventional Control of Electromagnetic Waves With Applications in Electrically Small Antennas, Nondiffracting Waves, and Metasurfaces* (Prof. Anthony Grbic, Chair), EE

Kyojin David Choo, *Charge-Domain Analog/Mixed-Signal Circuits and Applications* (Prof. David Blaauw, Chair), EE

Ali Darvishian, *Design and Analysis of Extremely Low-Noise MEMS Gyroscopes for Navigation* (Prof. Khalil Najafi, Chair), EE

Srayan Datta, *Extracting Insights From Differences: Analyzing Node-aligned Social Graphs* (Prof. Eytan Adar, Chair), CSE

Aniket Anand Deshmukh, *Kernel Methods for Learning With Limited Labeled Data* (Prof. Clayton Scott, Chair), EE:S

Vikas Dhiman, *Towards Better Navigation: Optimizing Algorithms for Mapping, Localization and Planning* (Prof. Jason Corso, Chair), EE:S

Mark Dong, *Frequency Comb Generation From Stimulated Brillouin Scattering and Semiconductor Laser Diodes* (Profs. Steven Cundiff and Herbert Winful, Co-chairs), EE

Heather Joan Ferguson George, *Electron Dynamics of TiN Thin Films and InGaN/GaN Dot-in-Nanowires* (Prof. Theodore Norris, Chair), EE

Han Guo, *Efficient Algorithms for Light Transmission, Focusing and Scattering Matrix Retrieval in Highly Diffusive 3D Random Media* (Profs. Eric Michielssen and Raj Rao Nadakuditi, Co-chairs), EE

David Hong, *Learning Low-Dimensional Models for Heterogeneous Data* (Profs. Laura Balzano and Jeffrey Fessler, Co-chairs), EE:S

Jiachen Huang, *Classical Computation in the Quantum World* (Prof. Yaoyun Shi, Chair), CSE

Chad Huard, *Nano-Scale Feature Profile Modeling of Plasma Material Processing* (Prof. Mark Kushner, Chair), EE

Animesh Jain, *Addressing Memory Bottlenecks for Emerging Applications* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

Sunmin Jang, *A CMOS Digital Beamforming Receiver* (Prof. Michael Flynn, Chair), EE

Yeonjoo Jeong, *Bio-inspired Neuromorphic Computing Using Memristor Crossbar Networks* (Prof. Wei Lu, Chair), EE

Chengang Ji, *Manipulating Light at Micro- and Nano-Scale: Enable Photonic Structures Toward Real-World Applications* (Prof. Jay Guo, Chair), EE

Yiding Ji, *From Security Enforcement to Supervisory Control in Discrete Event Systems: Qualitative and Quantitative Analyses* (Prof. Stéphane Lafortune, Chair), ECE

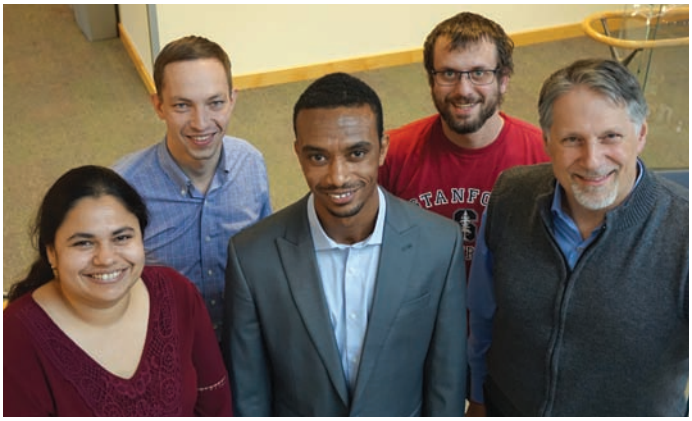
Yunhan Jia, *Securing Modern Appified Platform Through Systematic Program Analysis and Design* (Prof. Z. Morley Mao, Chair), CSE

Jiqing Jiang, *Millimeter-Scale Encapsulation of Wireless Resonators for Environmental and Biomedical Sensing Applications* (Profs. Yogesh Gianchandani and Scott Green, Co-chairs), ECE

Yiping Kang, *From Compute to Data: Across-the-Stack System Design for Intelligent Applications* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

Ram Srivatsa Kannan, *Enabling Fairness in Cloud Computing Infrastructures* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

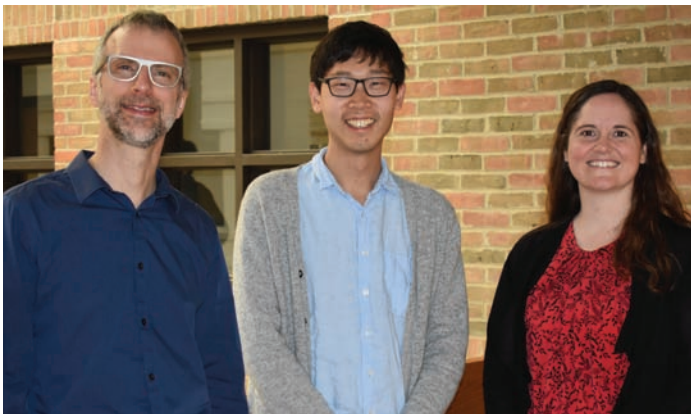
Seonghoon Kim, *Coherent Nonlinear Phenomena in Subwavelength-Grating Based Microcavities* (Profs. Hui Deng and Duncan Steel, Co-Chairs), EE



Mohsen Heidari Khoozani, *Capacity, Error Exponent, and Structural Results for Communication Networks* (Prof. Sandeep Pradhan, Chair), EE:S

John Kloosterman, *Data Resource Management in Throughput Processors* (Prof. Scott Mahlke, Chair), CSE

Yuqing Kong, *Eliciting and Aggregating Information: An Information Theoretic Approach* (Prof. Grant Schoenebeck, Chair), CSE



Avish Kosari, *Energy-Efficient Integrated Circuits and Systems to Bridge the Gap Between Power and Performance in Wireless Sensor Networks* (Prof. David Wentzloff, Chair), EE

Matthew Kvalheim, *Aspects of Invariant Manifold Theory and Applications* (Profs. Jessy Grizzle and Shai Revzen, Co-chairs), EE:S

Wootaek Lim, *Ultra-Low Power Circuit Design for Miniaturized IoT Platform* (Prof. David Blaauw, Chair), EE

Shih-Chieh Lin, *Cross-Layer System Design for Autonomous Driving* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

Gregory Ledva, *Learning and Control Applied to Demand Response and Electricity Distribution Networks* (Prof. Johanna Mathieu, Chair), EE:S

Kyuseok Lee, *An Energy-Efficient CMOS Image Sensor With Embedded Machine Learning Algorithm* (Prof. Euisik Yoon, Chair), EE

Sang Won Lee, *Improving User Involvement Through Live Collaborative Creation* (Profs. Georg Essl and Walter Lasecki, Co-chairs), CSE

Bowen Li, *Distributionally Robust Optimal Power Flow With Strengthened Ambiguity Sets* (Prof. Johanna Mathieu, Chair), EE:S

Qiaochu Li, *Photoacoustic Technologies Beyond Medical Imaging-PASA and LGFU* (Prof. Jay Guo, Chair), EE

Xiao Liu, *Energy Transfer in Heterogeneous Organic Material Systems* (Prof. Stephen Forrest, Chair), EE

Adam Mendrela, *Bidirectional Neural Interface Circuits With On-Chip Stimulation Artifact Reduction Schemes* (Profs. Michael Flynn and Euisik Yoon, Co-chairs), EE

Mehrdad Moradi, *Software-Driven and Virtualized Architectures for Scalable 5G Networks* (Prof. Z. Morley Mao, Chair), CSE

Tal Rove Nagourney, *High-Q Fused Silica Micro-Shell Resonators for Navigation-Grade MEMS Gyroscopes* (Prof. Khalil Najafi, Chair), EE

Ashkan Nikravesh, *Systems and Methods for Measuring and Improving End-User Application Performance on Mobile Devices* (Prof. Z. Morley Mao, Chair), CSE

Byoungchan Oh, *Architecting Memory Systems for Emerging Technologies* (Profs. Ronald Dreslinski Jr. and Trevor Mudge, Co-chairs), EE

Junhyuk Oh, *Efficient Deep Reinforcement Learning via Planning, Generalization, and Improved Exploration* (Prof. Satinder Singh Baveja, Chair), CSE

Doowon Lee, *Decompose and Conquer: Addressing Evasive Errors in Systems on Chip* (Prof. Valeria Bertacco, Chair), CSE

Ryan Marcotte, *Adaptive Communication for Mobile Multi-Robot Systems* (Prof. Edwin Olson, Chair), CSE

Dhanvin Mehta, *Multi-Policy Decision Making for Reliable Navigation in Dynamic Uncertain Environments* (Prof. Edwin Olson, Chair), CSE

Tai Qiao, *Scattering of Ocean Surfaces in Microwave Remote Sensing by Numerical Solutions of Maxwell Equations* (Prof. Leung Tsang, Chair), EE

Yuru Shao, *Preventing Capability Abuse Through Systematic Analysis of Exposed Interfaces* (Prof. Z. Morley Mao, Chair), CSE

Srinagesh Sharma, *Machine Learning Applications in Spacecraft State and Environment Estimation* (Profs. James Cutler and Clayton Scott, Co-chairs), EE:S

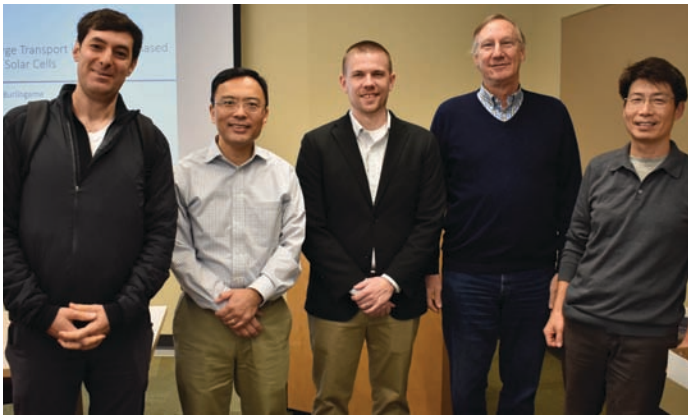
Morteza Sheikhsofla, *Turn-Key Stabilization and Digital Control of Scalable, N GTI Resonator Based Coherent Pulse Stacking Systems* (Prof. Almantas Galvanauskas, Chair), EE

Weitian Sheng, *A Full Wave Electromagnetic Framework for Optimization and Uncertainty Quantification of Communication Systems in Underground Mine Environments* (Prof. Eric Michielssen, Chair), EE

Yao Shi, *Millimeter-Scale and Energy-Efficient RF Wireless System* (Profs. David Blaauw and David Wentzloff, Co-chairs), EE

Matthew Skach, *Thermal Energy Storage for Datacenters With Phase Change Materials* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

Youngbae Son, *Solution-processed Amorphous Oxide Semiconductors for Thin-film Power Management Circuitry* (Prof. Becky Peterson, Chair), EE



Shiming Song, *Design Techniques for High Performance Wireline Communication and Security Systems* (Prof. Zhengya Zhang, Chair), EE

Wei Tang, *Design of Detectors and Decoders for MIMO Wireless Systems* (Prof. Zhengya Zhang, Chair), EE

Arash Ushani, *Understanding a Dynamic World: Dynamic Motion Estimation for Autonomous Driving Using LIDAR* (Ryan Eustice, Chair), CSE

Yongjie Wang, *Solar Water Splitting on Low-Dimensional Semiconductor Nanostructures* (Prof. Zetian Mi, Chair), ECE

Yue Wang, *Interactive Machine Learning With Applications in Health Informatics* (Prof. Qiaozhu Mei, Chair), CSE

Daniel Weyer, *Design of Digital FMCW Chirp Synthesizer PLLs Using Continuous-Time Delta-Sigma Time-to-Digital Converters* (Prof. Michael Flynn, Chair) EE

Steven Wilson, *Computational Linguistic Models for Personal Values and Human Activities* (Prof. Rada Mihaclea, Chair), CSE

Mason Wright, *Stable Profiles in Simulation-Based Games via Reinforcement Learning and Statistics* (Prof. Michael Wellman, Chair), CSE

Hsi-Shou Wu, *Energy-Efficient Neural Network Architectures* (Profs. Marios Papaefthymiou and Zhengya Zhang, Co-chairs), EE

Salessawi Ferede Yitbarek, *Hardware Mechanisms for Efficient Memory System Security* (Prof. Todd Austin, Chair), CSE

Yi Yuan, *Vertical Self-Defined Thermoelectric Legs for Use in Thin Film Micro Thermo Electric Generators (uTEG)* (Prof. Khalil Najafi, Chair), EE

Seyed Amin Sandoughsaz Zardini, *Sea of Electrodes Array (SEA): Customizable 3D High-Density High-Count Neural Probe Array Technology* (Prof. Khalil Najafi, Chair), EE

Biqiao Zhang, *Improving the Generalizability of Speech Emotion Recognition: Methods for Handling Data and Label Variability* (Prof. Emily Mower Provost, Chair), CSE

Yiqun Zhang, *Energy Efficient Hardware Design for Securing the Internet-of-Things* (Prof. Dennis Sylvester, Chair), EE

ALUMNI NEWS

Katie Bouman Was a Key Player in the First-ever Image of a Black Hole

Dr. Katie Bouman (BSE EE 2011) was part of an international team of over 200 scientists that figured out how to see the invisible – a black hole.

Einstein first predicted the presence of black holes as part of his theory of relativity, but even he had doubts that the confounding phenomenon actually existed. Over the next century, more pieces of evidence assembled: massive energy signatures that couldn't be explained by stars alone, the cosmic sound of two black holes colliding, and finally the detection of gravitational waves. But they were never seen.

Images of the black hole were taken in April 2017 over five days using an intercontinental network of radio telescopes called the Event Horizon Telescope (EHT). But those images needed some work. It took two years before the first ever image of a black hole was released on April 10, 2019, and Bouman helped make that happen.

After graduating from Michigan with a degree in electrical engineering, she enrolled as a grad student at MIT where she developed a crucial algorithm that helped devise the imaging method used for the black hole project. It was, in essence, an image processing problem, not entirely unlike a project she did in her undergraduate senior design course, taught by Prof. Alfred Hero.

"She developed a sophisticated and elegant method that basically estimated the distortion pattern that came out of these very poor lenses, and then used that estimate to correct the lens," Hero says. "She was just outstanding."

The image that Bouman helped create provides confirmation of more than a century of theory and will open up entirely new avenues of study.

The first ever image of a black hole located in the center of Messier 87 (M87), an elliptical galaxy some 55 million light-years from Earth. Image by the Event Horizon Telescope Project and released by the National Science Foundation.

Tom Conrad's Journey Through Art and Science

Alumnus Tom Conrad (BSE CE 1992) visited campus as the 2018 CSE Alumni Merit Award recipient. Conrad, a software designer with a long career at fast-growing tech firms, delivered a lecture on finding his passion in the software world. The talk, titled "Art Meets Science: My Journey from Apple to Pandora to Snapchat," offered advice to the audience on how to find fulfillment in CS and gave a look at how he followed his passion throughout his many career moves.

Conrad has spent the last 25 years as an engineering, product, and design leader for both consumer and enterprise software companies. Currently, he serves on the Board of Directors at Sonos, the smart speaker company. Conrad was most recently the Vice President of Product at Snap Inc where he led the company's product design efforts. Prior to Snap, Conrad was part of the team that created Pandora and he spent a decade there serving as Chief Technology Officer and EVP of Product. Conrad started his career at Apple as an engineer on the Finder and System Software teams.

> **It's time for me to put my energy outside of tech, into music, food, photography and things closer to art than entrepreneurship.** — Tom Conrad

Paul Daugherty is Changing How We Think About Business in the Age of AI

Paul Daugherty (BSE CE 1986) is Chief Technology and Innovation Officer at Accenture, where he oversees overall technology strategy, research and development, and ecosystem relationships, and is responsible for developing Accenture's business in emerging technologies such as artificial intelligence, cloud computing, and blockchain. Daugherty recently visited campus to deliver a talk about his work in AI for business, titled "Human + Machine: Reimagining Work in the Age of AI." The talk described Daughtery's extensive research into how organizations deploy AI to leap ahead of competitors.

Daugherty has played a key role in evolving Accenture's technology business to respond to changes in the industry. He developed the Digital Business vision and helped shape Accenture's early moves to establish its digital business leadership. He founded Accenture's cloud computing business and was instrumental in launching Accenture's SaaS, big data, and open source businesses, and played a key role in the company's technology business during the major transitions to client/server computing and internet-based computing.

Daugherty is co-author of *Human + Machine: Reimagining Work in the Age of Artificial Intelligence*, which was published by Harvard Press in 2018. In it, he writes that the essence of the AI paradigm shift is the transformation of all business processes within an organization, and provides a management playbook for the business of AI.

Prof. Rhonda Franklin Presents Willie Hobbs Moore Lecture, and Talks About the Future of Women in Engineering

Inspired by NASA astronauts, Prof. Rhonda Franklin (MS PhD EE 1990 1995) came to U-M to study electrical engineering. While at U-M, she met some of her personal heroes: astronauts Anthony England, Mae Jamison, and Charles Bolden.

"Coming to Michigan is pretty awesome," Prof. Franklin said. "You imagine something, and it just happens, right? Because this is that kind of place."

Today, Prof. Franklin is a Professor of Electrical and Computer Engineering at the University of Minnesota, Twin Cities, where she teaches applied electromagnetics and microwave circuits. Her research focuses on developing design techniques for high-speed electronic integrated circuit integration, integrated packaging, miniaturization, and novel material characterization for RF applications in communication systems and bio/nano-medicine.

As the 2018 Willie Hobbs Moore Distinguished Lecturer, Franklin returned to U-M to speak about her research, as well as the challenges affecting diverse demographic representation in STEM fields. Speaking of those from underrepresented groups who would become full professors, she emphasized that it is a lengthy process, and that while progress may be slow, it is happening.

Prof. Herbert Winful presents Prof. Franklin with the 2018 Willie Hobbs Moore Award.

> **Coming to Michigan is pretty awesome. You imagine something, and it just happens, right? Because this is that kind of place.** — Rhonda Franklin

Computing Visionary Samuel Fuller Honored by Michigan Engineering

Samuel H. Fuller (BS EE 1968), a thought leader in computing who counts among his achievements a key role in developing one of the first internet search engines, received the highest accolade given by Michigan Engineering: the Alumni Medal.

Sam Fuller (center) was presented with the 2018 Alumni Medal at an awards ceremony held on October 5. Also pictured: Alec D. Gallimore, the Robert J. Vlasic Dean of Engineering (right), and Tia Sutton, the Chair of the Michigan Engineering Alumni Board (left).

Fuller is an electrical engineer, computer scientist, teacher, mentor, author, business leader, and lifelong innovator. He is currently CTO emeritus and distinguished scientist at Analog Devices, Inc., a multinational semiconductor company where, as CTO, he created a product strategy connecting the physical world to the power of the digital world that include sensors, silicon, and software.

Prior to ADI, Fuller was vice president of research at Digital Equipment Corporation. There he founded and led the firm's global research organization, fostering disruptive innovations including the development of RISC computers, the Altavista search engine, the advancement of networked computing, and the commercialization of Ethernet in partnership with Xerox PARC, Intel, and 3COM. He also developed collaborative projects with leading research universities. He was a co-founder of Project Athena at MIT that deployed advanced, networked workstations, resulting in the development of the X Windows System for workstations and the Kerberos authentication system that is widely deployed today, including by U-M.

Fuller presented the talk, "The 3rd Revolution in Computing has Just Begun: Connecting the Physical World to the Power of the Digital World," to faculty, students, and alumni during Homecoming 2018.

> **In his decades of leadership both in academia and industry, Sam has shown extraordinary achievement from the earliest days of computing to the modern era of the Internet of Things.**
>
> — Mingyan Liu, Peter and Evelyn Fuss Chair of Electrical and Computer Engineering

Dev Goyal is Making Healthcare More Precise With Machine Learning

Dev Goyal (PhD CSE 2018) is a Lead Machine Learning Engineer at San Jose-based startup HEALTH[at]SCALE, which is dedicated to matching the world's patients to the right treatments and providers through the use of personalized recommendations produced by predictive machine intelligence.

At Michigan, Goyal was advised as a PhD student by Profs. Jenna Wiens and Zeeshan Syed (formerly a tenured faculty member at Michigan and currently the CEO of HEALTH[at]SCALE), researching the application of machine learning for early prediction of Alzheimer's disease. Excited at the practical applicability of machine learning to high priority challenges in healthcare, he joined HEALTH[at]SCALE as its first non-founding employee in 2018 after interning with them the previous summer.

Through his role at the company, Goyal has been centrally involved in the development of some of the largest deployments to date of machine learning for healthcare use cases, helping payers and providers manage populations comprising tens of millions of individuals in live production settings.

How U-M Inspired Tony Hsu's Quest to Understand the Legacy of His Grandfather, Iconic Chinese Poet Xu Zhimo

On a crisp Ann Arbor day in the fall of 1964, Tony Hsu (BSE EE 1968), a freshman on campus, was handed a flier announcing a lecture about a famous chinese poet.

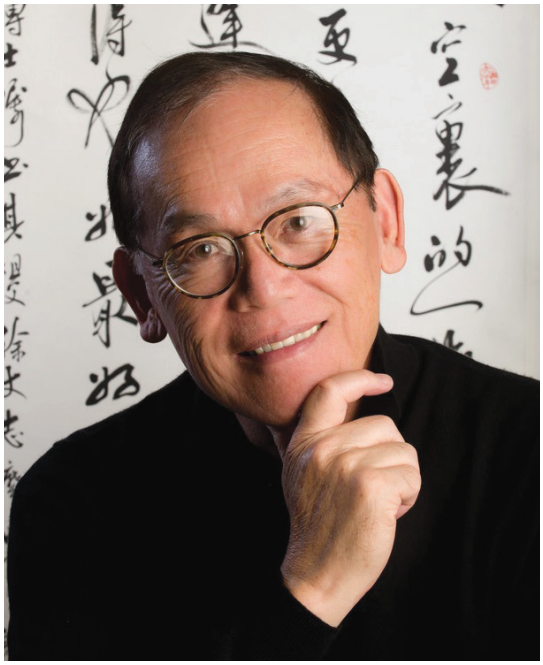
"Hey, Tony, is this guy a relative of yours?" Hsu's friend joked, oblivious, for the poet in question – Hsu Chih-Mo (now more commonly known as "Xu Zhimo") – was indeed Hsu's grandfather.

"This one moment at U-M sent me on the odyssey that would bring some of the greatest meaning to my life," Hsu says.

For the past decade, Hsu has been retracing his grandfather's journey around the world, researching his life and works. Zhimo's most famous poem, "A Farewell to Cambridge," is often quoted at graduations and other ceremonies for its nostalgic tone and message of a fond farewell. For Hsu, this poem echoed his own feelings about leaving U-M.

"When I first stepped onto the U-M campus, I took in the sweeping grounds and gracious old buildings, and my whole perspective shifted," Hsu said. "Here, finally, was a landscape that allowed me to breath. Maybe gave me the space to dream."

Hsu, who studied electrical engineering here before earning a master's and PhD from Yale University, went into industry and had a very successful career as an executive for the Newport Corporation for 12 years before transitioning to starting new companies as well as venture capital. Now retired, he has recently published a biography on his grandfather called, *Chasing the Modern: The Twentieth-Century Life of Poet Xu Zhimo.*



> **This one moment at U-M sent me on the odyssey that would bring some of the greatest meaning to my life.** — Tony Hsu

Smita Krishnaswarmy: Logic and Error Correction, in Circuits and in Genetics

Smita Krishnaswamy (PhD CSE 2008) is an Assistant Professor in the Department of Genetics at the Yale School of Medicine and Department of Computer Science. She is also affiliated with the Yale Center for Biomedical Data Science, Yale Cancer Center, and Program in Applied Mathematics.

At Michigan, Krishnaswamy's research focused on algorithms for automated synthesis and probabilistic verification of nanoscale logic circuits. Her dissertation, "Design, Analysis and Test of Logic Circuits Under Uncertainty," won the 2009 Outstanding Dissertation Award in the area of "New directions in circuit and system test" from the European Design and Automation Association (EDAA).

After Michigan, Krishnaswamy spent two years at IBM's TJ Watson Research Center as a researcher in the systems division where she worked on automated bug finding and error correction in logic. It was at this time that she realized her work could translate to the domain of genetics research.

Krishnaswamy's current research focuses on developing unsupervised machine learning methods to denoise, impute, visualize and extract structure, patterns, and relationships from big, high-throughput, high-dimensional biomedical data. Her methods have been applied to a variety of datasets from many systems including embryoid body differentiation, zebrafish development, the epithelial-to-mesenchymal transition in breast cancer, lung cancer immunotherapy, infectious disease data, gut microbiome data, and patient data.

Want to Know About Networks? Ask Craig Labovitz

Want to know about networks? Ask Craig Labovitz (MSE PhD CSE 1994, 1999). Currently the CTO at Nokia DeepField, Labovitz has developed the core technology, key patents, architecture, and commercial strategy behind more than $1 billion in sales of large enterprise and telecom security products. His technology is deployed by more than 700 Internet Service Providers, cable operators, content providers, and mission-critical networks around the globe.

While a graduate student at Michigan, Labovitz was a co-author of "Internet Routing Instability," a paper on internet performance that was later recognized with an ACM-SIGCOMM Test of Time Award in 2008. This work served as a catalyst for significant changes in commercial internet routing software implementations throughout the world and helped lead to the formation of the highly successful security firm Arbor Networks in 2001, where over the next decade he held the roles of Founding Architect, Chief Architect, and Chief Scientist.

In 2011, Labovitz and fellow alumnus Joe Eggleston (BSE CE 1998, MSE CSE 1999) co-founded cloud analytics company DeepField, where Labovitz served as CEO. DeepField addressed the challenges associated with understanding the complexity that had arisen from the ways that companies now build and operate on the internet.

"The internet, together with the cloud, are the most complicated things built in human history," said Labovitz when remarking on the formation of DeepField. DeepField was acquired by Nokia in 2017.

Zachary Lemnios Talks About the Current Golden Age of Engineering

Cars that drive themselves. Algorithms that predict human behavior. Powerful mini-computers that we carry around in our pockets. Technology has advanced tremendously in the past few decades, but where do we go from here? The Honorable Zachary J. Lemnios believes we have only just begun.

ECE Chair Mingyan Liu presents Zachary Lemnios with a block M memento as the 2018 ECE Alumni Impact Award winner.

Mr. Lemnios (BS EE) presented the talk, "Electrical Engineering and Computer Science in the Golden Age of Engineering," as the 2018 recipient of the ECE Alumni Impact Award, the highest recognition granted by ECE to its alumni. He spoke about the potential for electrical engineers and computer scientists to revolutionize the speed and scale of current technologies, impacting the world in entirely new ways.

Lemnios leads Physical Sciences and Government Programs globally across IBM Research. Strategic initiatives include quantum computing, neuromorphic devices and architectures, molecular imaging, silicon nanophotonics, and magnetic memory technology. Before that, he served as VP of Research Strategy and Worldwide Operations where he led the formation and execution of the IBM Research strategy and operations across IBM's twelve global laboratories and network of co-laboratories.

In 2009, Lemnios was confirmed as The Honorable Assistant Secretary of Defense (Research & Engineering) by the United States Senate. In this position, he was the Chief Technology Officer for the Department of Defense and shaped the Department's technical strategy to support the President's national security objectives and the Secretary's priorities.

> **We have a remarkable opportunity to make an impact on the world as never seen before.** — The Honorable Zachary Lemnios

Kyla McMullen is Enhancing First Responder Effectiveness

First responders typically work in hazardous conditions caused by hurricanes, tsunamis, earthquakes, fires, and terrorism events. In the case of firefighters, the smoke and darkness that often inhibit vision have left responders plagued by disorientation and failure to identify appropriate paths to reach victims and move them to safety.

Kyla McMullen (MSE PhD CSE 2007 2012), an assistant professor in the Department of Computer & Information Science & Engineering at the University of Florida, believes the use of 3D sounds can help firefighters find their way when visual conditions are impeded. With a system developed by McMullen, the responder would hear unique 3D audio cues representing the locations of targets of interest, such as victims, exits, fire panels, and water sources. This work earned a National Science Foundation CAREER Award.

While 3D audio has been studied before, none of the research has addressed the challenges in designing 3D sound for use in real-world conditions. All existing research results were derived in quiet, tightly controlled experiments. McMullen and her team will be working closely with Gainesville Fire Rescue to develop a local, open-source testbed.

The team will evaluate firefighters' performance in search-and-rescue scenarios and will use the results to establish 3D sound design guidelines. The information they garner will address three areas: realistic 3D sound rendering, rapid detection of changes in 3D sound, and effects of competing sounds on accurately distinguishing the sound of interest.

The work will significantly contribute to the current understanding of the usability of 3D display systems and human factors associated with using 3D audio to convey spatial information in real-world contexts. McMullen's research program aims to unobtrusively help first responders maintain awareness of their surroundings, decreasing the number of casualties experienced in emergency environments in the process.

Piston Group Leader Amit Singhi's Four-Point Play to Life

In the early 1990s, Amit Singhi (MSE EE:S 1989) led a software team developing one of the very first in-car navigation systems in the U.S. At a time when computers were housed in bulky towers, sang dial-up tones through modems, and the internet looked like a text adventure, Singhi and his team at General Motors fit a computer into the dash that allowed drivers to plan a route, search local businesses, and check traffic. The project was a feat of engineering, especially considering the ruggedness required to survive on the road.

Singhi eventually shifted from engineering into business, but the technical chops and leadership he took on in this project echo through his career. Today, Singhi is Chief Operating and Financial Officer of Piston Group, one of the largest minority-owned automotive suppliers in the country with annual revenues near $2B.

Singh credits part of his success to his approach to life: a four-part philosophy which is comprised of 1) Having a positive attitude, 2) Care about the people who are impacted by your work, 3) Be passionate about what you do, and 4) Engage in a relentless pursuit of excellence.

> **Relentless means never giving up, and pursuit of excellence means always trying to get better with continuous improvement," Singhi says. "What is your legacy going to be?**

Dowson Tong, VP of Tencent, Talks to Students as the 2018 ECE Alumni Merit Award Winner

Dowson Tong (BS CE 1994), VP of the world's largest gaming and social company, spoke to students about AI, pursuing a global maximum in your career, and what it's like to work in China when you don't speak Mandarin. He gave his talk as the 2018 College of Engineering Alumni Merit Award Winner for ECE.

Tong came to the U.S. in the early '90s, and followed up his degree at Michigan with an M.S. in Electrical Engineering from Stanford. He had a successful career as director of engineering where he managed a team of 30 to 40 engineers, and he and his wife had just welcomed the birth of their first child.

But then Tong received a job offer with a new technology company called Tencent, headquartered in Shenzhen, China. His good friend Martin Lau, president of the company, recruited him. He had met Lau while both were undergraduate students at Michigan. He took the job, even though he didn't speak Mandarin and had to get used to an entirely different work culture.

Tong now serves as the Senior Executive Vice President of Tencent, which provides entertainment and cultural enrichment to over 1 billion users. He had led the research and development of Tencent's social networking platforms QQ and Qzone and the associated content and value-added services. He currently oversees Tencent's cloud services, AI applications for smart industries such as smart retail, connected cars, online education and digital healthcare. He co-leads Tencent's advertising business. He also serves as the chairman of the Tencent Music Entertainment Group.

Dowson Tong chats with a student after his presentation as the 2018 ECE Alumni Merit Award Winner.

> **"I was able to come over and experience a whole new world, and that lesson gave me the courage to try new things throughout my career."**
>
> – Dowson Tong

Alumni Briefs

THOMAS KNOLL (BSE Physics 1982; MSE CICE 1984) won the 2019 Academy Award for scientific and technical achievement for inventing Photoshop. While a student at Michigan, Knoll, a PhD student in computer vision and son of U-M Nuclear Engineering department chair and alumnus Glenn Knoll, was working on how to make factory robots work better. He wrote computer algorithms that would find the edges of objects within an image. One algorithm, called the Sobel Edge Technique, was the genesis of Photoshop.

The Oscar is shared with Knoll's brother, John Knoll, for the original architecture, design, and development, as well as Mark Hamburg for his continued development and engineering of Adobe Photoshop.

SANJAY RAMAN (PhD EE 1998), associate vice president for the Virginia Tech National Capital Region, president and CEO of the Virginia Tech Applied Research Corporation, and a professor of Electrical and Computer Engineering has been named Dean of the College of Engineering at the University of Massachusetts, Amherst, effective August 2019.

JEREMY MULDAVIN (BSE Engineering Physics; MSE PhD EE) returned to campus as an ECE Distinguished Lecturer to speak about the Department of Defense's Microelectronics Innovation for National Security & Economic Competitiveness (MINSEC) initiative and related advanced secured electronics foundry challenges. Specifically, he spoke about how the future of cyber and social networks will impact safety and security. Muldavin is a member of the Office of the Deputy Assistant Secretary of Defense for Systems Engineering and Senior Staff member of MIT Lincoln Laboratory.

DIMITRIOS PEROULIS (MSE PhD EE 1999 2003) has been named the Michael and Katherine Birck Head of the School of Electrical and Computer Engineering at Purdue University, effective May 2019.

Alumni Briefs

DARLENE J. PHILLIPS (BS EE), Director of strategic policy and external affairs at PJM Interconnection, has been appointed to the U.S. Department of Energy's Electricity Advisory Committee. The committee advises the Department of Energy in defining strategies for long-term planning and priorities for power grid modernization.

DANIEL LEWIS (BS EE) assumed the role of president and CEO of MoSys, Inc. He previously served as a member of the Company's Board of Directors and has over 30 years of executive leadership and semiconductor industry experience, primarily in sales and marketing positions.

MIN SUN (PhD EE:S) has been appointed the first Chief Artificial Intelligence Scientist at Appier, a leading artificial intelligence (AI) company. He previously served as Assistant Professor in the Department of Electrical Engineering at the National Tsing Hua University.

Marvell Technology Group Ltd. acquired Cavium, Inc., creating a leading semiconductor company focused on the infrastructure market, offering customers a substantial portfolio of storage, processing, networking, wireless connectivity, and security products. **SYED ALI** (MSE EE) was a co-founder of Cavium and served as its President, Chief Executive Officer and Chairman of the Board of Directors since the company's launch in 2000.

KATHERINE J. HERRICK (BSE MSE PhD EE 1993 1995 2000) received the 2019 Technology Champion Award from Inside Tucson Business, which honors women of influence. Herrick, senior engineering fellow at Raytheon, is also President of the Advisory Board for Women in Science and Engineering at The University of Arizona, and she serves on the U-M ECE Council.

Hygieia, co-founded by **ERAN BASHAN** (PhD EE:S 2008) to improve and simplify insulin treatment, was granted FDA approval for their mobile app that provides automatic insulin titration for all types of insulin regimens.

KLA, formerly KLA-Tencor, opened a new R&D office in Ann Arbor. KLA is a global provider of advanced process control solutions for manufacturing wafers and reticles, integrated circuits, and packaging. The company sees itself as the nexus of electron and photon optics, sensor technology, and artificial intelligence. **RICK WALLACE**, (BSE EE 1982), serves as President and CEO, and John McLaughlin, a U-M alum who previously served as the Director of Corporate and Foundation Relations for the College of Engineering, is the Ann Arbor site leader.

JENNIFER REXFORD (MSE PhD CSE 1993 1996), Gordon Y. S. Wu Professor in Engineering and Chair of Computer Science at Princeton University, was awarded the CRA-E Undergraduate Research Faculty Mentoring Award for providing exceptional mentorship, undergraduate research experiences, and, in parallel, guidance on admission and matriculation of their students to research-focused graduate programs in computing. Rexford's nomination letter noted that "despite being the Department Chair of Computer Science at Princeton, she still makes time to meet personally with her undergraduate advisees, often taking out more than an hour every week for each advisee. Mentees thrive in this supportive environment, becoming highly confident in their own skin…."

University of Illinois Professor **WILLIAM SANDERS** (PhD CSE 1988) was named Herman M. Dieckamp Endowed Chair in Engineering. During his tenure as department head of Electrical and Computer Engineering, he led an aggressive faculty hiring campaign that has hired 35 new tenure-track, 8 teaching, and 5 research faculty since January 2014. In his research, Sanders and colleagues created one of the earliest secure power grid architectures as well as the assessment tools and metrics to quantify smart grid resilience.

In July 2019, Ford Autonomous Vehicles LLC, a component of Ford Motor Company, acquired Quantum Signal, an advanced engineering research and development company specializing in robotics, simulation, and algorithm development. Founded in 1999 by **MITCHELL ROHDE** (BSE MSE EE 1994 1996; MSE PhD BME 1997, 2000) and former faculty member and advisor Bill Williams, Quantum Signal is expected to help Ford reach its goals in the area of autonomous vehicles and mobility products and services, working with teams throughout the overall organization to build new, innovative solutions to some very hard problems. Quantum Signal, now renamed Quantum Signal AI, will continue to operate as an independent, wholly-owned subsidiary, led by CEO Mitch Rohde.

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EMAG Technologies, Inc.
Facebook, Inc.
Ford Motor Company
General Electric Company
Google Foundation
Google, Inc.
Hadavi Gift Fund of the Morgan Stanley Global Impact Funding Trust
IBM Corporation
Intel Corporation
International Joint Conference on Artificial Intelligence
ITHAKA
J.P. Morgan Chase & Co.
Jenny H. Krauss & Otto F. Krauss Charitable Foundation
Kahng Foundation
Keysight Technologies, Inc.
Laird Alpern Charitable Fund
Lam Research Foundation at the Community Foundation of Silicon Valley
Laura Ellen and Robert Muglia Family Foundation
Lavigne Family Charitable Fund of the Fidelity Charitable Gift Fund
Lockheed Martin Corporation Foundation
Masnari Living Trust
Medtronic Inc.
Michigan eLab
Microsoft Corporation
Nandita and Subhachandra Chandra Family Fund of Vanguard Charitable
Northrop Grumman Space Technology
Oracle
Patrick & Charlotte Fischer Charitable Fund at Vanguard Charitable
Peter and Nancy Wurman Family Fund of The Fidelity Charitable Gift Fund
Philip A. Hadley Foundation of the Fidelity Charitable Gift Fund
Qualcomm Incorporated
Raytheon Company
Robert Bosch Automotive Steering
Robert Bosch LLC
Robert J. Armantrout TRTEE
Silicon Laboratories, Inc.
SoarTech
Steve and Debbie Grob Fund of the Fidelity Charitable Gift Fund
Stryker Corporation
Stryker Neuro, Spine and ENT
TD Ameritrade
Test Equity LLC
Texas Instruments Inc. and Texas Instruments Foundation
The Boeing Company
The Chang Family Foundation
The Eleanore Wolpaw and Jesse Brouhard Family at PNC Wealth Management
The Subramanian Charitable Fund of the Ayco Charitable Foundation
The Wallace Family Fund of the Silicon Valley Community Foundation
Toyota Motor Corporation
Toyota Research Institute, Inc.
University of Michigan Credit Union
Voxel51 LLC

Dr. Cyrus Hadavi Establishes the Hadavi Family Fellowship Fund to Help ECE Wolverines Change the World

It was December of 1977. The campus was a winter wonderland of sparkling snow and twinkling lights, and Cyrus Hadavi was just beginning his PhD in Electrical Engineering.

"It was a dream of mine to do my graduate study in the U.S.," Hadavi says. "I knew U-M was one of the top-ranked universities, especially in the field that I was studying, so it was very high on my list."

To help others achieve their goals of experiencing a U-M education, Hadavi has established the Hadavi Family Fellowship Fund, which will provide financial support to graduate students in ECE.

"I'm very grateful for the experiences I had during my graduate work," Hadavi says. "With this fund, I can help future students as well as the school itself."

Hadavi credits his advisors at U-M for giving him the tools to be a critical and creative thinker and for teaching him how to be a holistic problem solver. In addition, he got his first major exposure to a field that would become a crucial component in his career.

"I'm so glad that the University of Michigan immediately started offering different courses in A.I. [artificial intelligence]," he says. "That was one of the areas I was very interested in, and that provided the background for me in terms of how it can be applied to areas like planning and manufacturing and so on."

After working for a few different companies, Hadavi founded Adexa in 1994, a company he's run for the past 25 years.

> **It has always been my dream to start up my own company. I didn't want to be a very old man and look back and say, 'I wish I had done it.'**
>
> — Cyrus Hadavi

Adexa provides supply chain planning solutions for clients all over the world, including hundreds of Fortune 2000 industry leaders. Adexa uses comprehensive planning, modeling, and collaboration technologies to assist with the identification of strategic objectives. It then plans the supply chain to meet them, executes against the plan, and finally monitors and measures progress using hundreds of key performance indicators.

Hadavi has worked just as hard building the company culture as the company itself. "The pride that we have in doing what we're doing, the kind of passion that we have – make the company better, make the systems better, and provides a better environment and service for our customers in the end," Hadavi says.

Hadavi spent many hours in a computing center like this one. This photo, courtesy of the Bentley Historical Library, was taken in a computing center on campus in the late 1970s.

Should he ever leave Adexa, Hadavi says it will be to start something new. "That process of creativity – it's something that is very energizing, and there are so many things that one can do if you keep working at it," Hadavi says.

Hadavi's drive to create extends to the arts as well. He enjoys acrylic painting, he meditates every day, and he writes poetry and is considering publishing a book one day. Yet for all his passions, U-M has remained strong in his heart.

"It is a pleasure to be a small part of this great institution," he says.

IN MEMORIAM

CLASS OF 1940–1949

Dean Arden (1946; 11/4/18)
Edward Greer (1948, 1950; 12/10/18)
Charles Hansen (1946, 1950; 10/14/18)
Roger Higgins (1943; 1/1/17)
James Horgan (1947; 12/11/18)
Harvey Krasner (1949; 5/11/16)
Donald Kurtz (1944; 1/2/19)
G. Robert Leopold (1948, 1949; 1/12/19)
James Martin (1949; 4/5/19)
John Scott (1948; 1/25/19)
Richard Sharpe (1942; 11/19/14)
E. F. Sikorovsky (1948; 9/30/18)
John Smolak (1943; 1/4/12)
Morton Sobell (1942; 12/26/18)
Jack Sweeney (1949; 11/3/14)
Kenneth Throckmorton (1949; 12/6/18)
William Wheatley (1947, 1948; 10/16/18)
Raymond Williams (1949; 12/31/18)

CLASS OF 1950–1959

Richard Beaudry (1956, 1957; 10/3/18)
Norman Boettcher (1955; 8/31/18)
Marvin Borgeson (1959; 2/15/15)
Joseph Boyd (1954; 4/19/19)
Lester Browning (1958; 4/2/18)
Ellsworth Brunais (1952, 1956; 7/23/18)
Earl Burgering (1950; 11/20/18)
Donald Calhoun (1950; 2/1/18)
Ray Charles (1956; 6/2/18)
Paul Coleman (1954; 4/6/19)
Byron Custer (1948; 1/30/19)
Salvatore Davola (1951; 7/25/18)
John Frey (1952; 12/15/18)
Elmer Gilbert (1952, 1953, 1957; 6/16/19)
Gordon Haan (1959; 8/1/18)
Roger Harvey (1954; 1/1/16)
Thomas Hauck (1951; 5/22/19)
Harry Hedges (1954; 6/7/18)
Charles Hocking (1956; 5/14/19)
Jerome Hoheisel (1950; 10/15/18)
John Jacobsmeyer (1954, 1955; 5/24/18)
David Johnson (1959, 1960, 1967; 7/11/13)
Norman Johnson (1957, 1964, 1972; 7/6/18)
Thomas King (1959; 3/21/15)
James Kuiper (1957, 1958; 6/26/19)
Robert Little (1959, 1963; 5/25/19)
Ronald Malis (1957; 4/9/19)
Nino Masnari (1958, 1959, 1964; 5/19/18)
Leroy Mastic (1953, 1954, 1955; 2/19/19)
Stanley McDowell (1950; 4/17/19)
Kenneth McKeown (1950; 1/1/17)
Frank McNeill (1954; 1/18/19)
Stanley Miller (1951; 1/28/19)
Brian Moriarty (1958; 11/20/18)
Leland Moy (1955, 1958; 4/8/19)
Richard Nelson (1950; 3/22/19)
Gordon Piotrowski (1952; 5/6/17)
James Pua (1956; 3/2/18)
Louis Rotolo (1951; 8/5/18)
Phillip Sandford (1950; 12/1/17)
Marvin Schrebe (1959; 1/6/19)
Richard Thomas (1959, 1964; 12/2/18)
Daniel Vliet (1952; 8/11/17)
Basil Wentworth (1954; 3/31/19)
Marshall White (1951; 2/24/19)
Jerry Wright (1956, 1960; 1/6/16)
Hizir Yenigun (1957; 10/1/18)
David Zerbel (1956, 1960; 8/1/18)

CLASS OF 1960–1969

Carl Aleksoff (1962, 1963, 1969; 3/27/19)
Haluk Askin (1960; 4/10/19)
John Brunschwig (1966; 6/22/17)
Rhee Chong (1962, 1964, 1970; 1/21/11)
John Eklund (1963, 1964; 8/17/18)
Walter Ellison (1968; 8/13/18)
Edward Faris (1962, 1964; 2/15/19)
Bruce Foulke (1960; 12/4/18)
L. Daniel Gray (1962, 1964; 6/07/19)
James Jackson (1964, 1966, 1971; 7/22/18)
Samuel Jones (1965; 4/27/19)
Mary Katchmark (1968; 11/22/18)
Dale Krauss (1965; 5/27/19)
Charles Laidlaw (1962; 12/27/18)
Richard Rosenberg (1967; 3/19/19)
Gustav Schulwitz (1963; 10/8/18)
Paul Tremoulet (1967; 4/18/17)
Robert Trew (1969, 1975; 2/24/19)
Robert Vaughn (1961; 12/28/18)
Dwight Wahr (1965; 6/4/18)
Paul Wassenaar (1969; 3/30/19)
Francis Yockey (1964, 1965; 2/10/19)
Ronald Zeilinger (1960, 1964; 10/26/18)

CLASS OF 1970–1979

Vincent Amatangelo (1972, 1979; 2/11/19)
William Dibble (1970, 1971; 1/19/12)
Leslie Franke (1971; 7/16/18)
Theodore Johnson (1972; 12/19/02)
Alexander Kushnir (1976; 6/23/18)
George LeCompte (1971, 1974; 2/18/19
Leslie McDermott (1976; 4/14/18)
Keith Samuels (1977; 1/30/19)

CLASS OF 1980–1989

James Brooks (1982; 05/20/19)
Wilfred Nonnenmacher (1987; 3/18/19)
Donald Redick (1985; 12/14/16)
Cory Reina (1984, 1986; 4/16/19)
Rick Riolo (1988; 8/25/18)
Brian Stainforth (1988; 9/22/18)

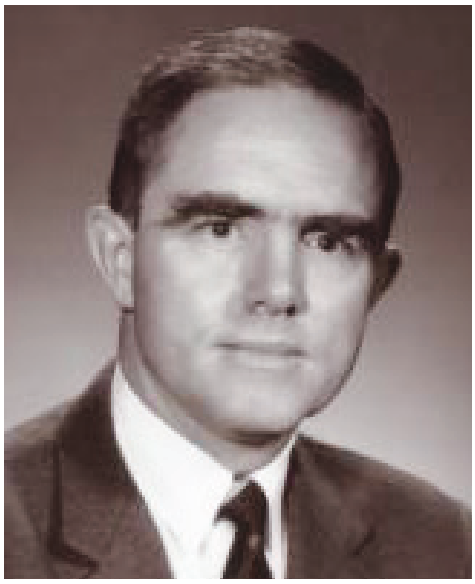
CLASS OF 1990–1999

James Mason (1991; 4/03/06)
Steven Nielson (1993; 2/13/19)
Jeffrey Wright (1991; 12/16/18)

CLASS OF 2000–2019

Steve Chapel (2013; 3/16/16)
Clifford Olmstead (2002; 4/24/19)

Norman Scott (1918–2018)



NORMAN R. SCOTT, professor emeritus of EECS, passed away on August 20, 2018 at the age of 100.

Scott received his BS and his MS degrees in Electrical Engineering from MIT in 1941. During World War II, he spent five years in the Army working on radar countermeasures and rose to the rank of major. He received his PhD in Electrical Engineering at the University of Illinois Urbana-Champaign in 1950.

He joined the University of Michigan in 1951, and later served as Associate Dean of the College of Engineering from 1966 until 1968. He then served as Dean of Engineering at the University of Michigan-Dearborn.

Scott was instrumental in the EECS Department's early development of an academic program in computers. In 1952, he presented the first electrical engineering course in computers, "Seminar in Computer Technology," and during the years following he managed to acquire computers for the instructional laboratories that he developed.

He was a member of the first western team to tour Soviet computing centers in 1958, and served on the Math and Computer Science Research Advisory Committee of the Atomic Energy Commission from 1961 until 1965. He visited Hokkaido, Tohoku, Tsukuba, and Kyoto Universities in Japan, where he conducted important research work in CAD/CAM and of computer architecture.

Scott was known for his outstanding capabilities as a teacher, mentor, and graduate advisor. For many years he served as the faculty advisor to the IEEE student chapter and as the chief undergraduate program advisor in computer engineering. He was highly regarded for his knowledge of theory and practice and fostered in his students enthusiasm, curiosity, and a desire to excel. On four separate occasions, he was selected as Eta Kappa Nu's Teacher of the Year. He was a Fellow of the IEEE.

Robert J. Trew (1944–2019)

ROBERT J. TREW (MSE PhD EE 1969 1975), alumnus, friend, and supporter of the department, passed away February 24, 2019, at the age of 74.

Dr. Trew led a distinguished life as a professor, administrator, and public servant. Most recently, he was the Alton and Mildred Lancaster Distinguished Professor (Emeritus) and former head of the Department of Electrical and Computer Engineering in North Carolina State University's College of Engineering. He also served as ECE Department Head at Virginia Tech and Case Western Reserve University.

He served as the Director of the Electrical, Communications, and Cyber-Systems (ECCS) Division in the Engineering Directorate of the National Science Foundation from 2009-2013.

From 1997-2001, he served as Director of Research for the Department of Defense, overseeing a $1.3 billion annual budget, and before this, he spent five years as a Program Manager in the Electronics Division for the U.S. Army Research Office.

His research was in the areas of semiconductors and microwave computer-aided design. He authored twelve patents, and has received numerous awards in his field, including the IEEE MTT-S Career Award, the IEEE Rudolph E. Henning Distinguished Mentor Award, the Harry Diamond Memorial Award, and the IEEE MTT-S Pioneer Award. He served as Editor-in-Chief of *Proceedings of the IEEE*, *IEEE Transactions on Microwave Theory and Techniques*, and *IEEE Microwave Magazine*. He was a Life IEEE Fellow.

Dr. Trew received the University of Michigan College of Engineering Alumni Society Merit Award in Electrical and Computer Engineering in 2003.

During an informal discussion years ago, Trew stated, "I remember my days in Ann Arbor with great fondness. In those days IMPATT and Gunn devices were the hot devices for research and there were opportunities in both device modeling and fabrication and testing. I fondly recall football Saturdays (I was in the stadium the day Woody Hayes tore up the yard marker), the Ann Arbor Street Art Fair (right outside East Engineering), the Dexter cider mill, and Pizza Bob's. I can't imagine a better educational experience."

This list includes active faculty (tenure-track, research scientists, and lecturers) as of September 2019. The primary departmental affiliation (either CSE or ECE) for each faculty member is listed first, followed by any secondary appointments in other departments (a key for the acronyms is found on page 99).

Ackerman, Mark S.
George Herbert Mead Collegiate Professor of HCI; Professor of Information, SI
Professor (courtesy), LHS
CSE

Adams, Michael
Assistant Research Scientist
CSE

Afshari, Ehsan
Professor
ECE

Ahmadi, Elaheh
Asst. Professor
ECE

Aktakka, Ethem Erkan
Asst. Research Scientist
ECE

Anastasopoulos, Achilleas
Assoc. Professor
ECE

Arthur, William
Lecturer III
CSE

Austin, Todd
Professor
CSE, ECE

Avestruz, Al-Thaddeus
Asst. Professor
ECE

Balzano, Laura
Assoc. Professor
ECE

Banovic, Nikola
Asst. Professor
CSE

Baveja, Satinder Singh
Toyota Professor of Artificial Intelligence
CSE

Beaumont, Jonathan
Lecturer III
CSE

Berenson, Dmitry
Assoc. Professor
ECE

Bertacco, Valeria
Arthur F. Thurnau Professor; Assoc. Dean for Academic Programs and Initiatives, Rackham Graduate School; Director, ADA Center
CSE

Bhattacharya, Pallab K.
Charles M. Vest Dist. Univer. Professor; James R. Mellor Prof.; Prof. (courtesy), AP
ECE

Blaauw, David T.
Kensall D. Wise Collegiate Professor
ECE

Brehob, Mark
Kurt Metzger Collegiate Lecturer IV
CSE, ECE

Cafarella, Michael J.
Assoc. Professor; Faculty Assoc. (courtesy), Survey Research Center; Institute for Social Research
CSE

Chai, Joyce
Professor
CSE

Chen, Peter M.
Arthur F. Thurnau Professor
CSE

Chen, Yu-Chih
Asst. Research Scientist
ECE

Cheraghchi, Mahdi
Asst. Professor
CSE

Chesney, David
Toby Teorey Collegiate Lecturer IV
CSE

Cho, Jae Yoong
Asst. Research Scientist
ECE

Chowdhury, Mosharaf
Asst. Professor
CSE

Corso, Jason
Professor
ECE, CSE

Darden, Marcus
Lecturer IV
CSE

Das, Reetuparna
Asst. Professor
CSE

DeOrio, Andrew W.
Lecturer IV
CSE

Deotare, Parag B.
Asst. Professor
ECE

Diaz, Kimberly Khalsa
Lecturer III
CSE

Dick, Robert
Assoc. Professor
ECE

Dreslinski, Ronald
Morris Wellman Faculty Development Assistant Professor
CSE

Durfee, Edmund H.
Co-director, TIKTOC; U-M Rehabilitation Engineering Research Center; Professor
CSE

England, Anthony W.
Dean, U-M Dearborn; Professor, EECS; Professor (courtesy), CLASP; AP
ECE

Ensafi, Roya
Asst. Professor
CSE

Fessler, Jeffrey A.
William L. Root Collegiate Professor of EECS; Professor (courtesy), AP; BME; RAD
ECE

Finelli, Cynthia
Professor, EECS; Professor (courtesy), Education; Director, Engineering Education Research Program
ECE

Flinn, Jason
Professor
CSE

Flynn, Michael P.
Professor
ECE

Forrest, Stephen R.
Peter A. Franken Dist. University Professor; Paul G. Goebel Professor; Prof. (courtesy), PHY; MSE; AP
ECE

Fouhey, David
Asst. Professor
CSE

Freudenberg, James S.
Professor
Program Director, Automotive Engineering, ISD
ECE

Fu, Kevin
Assoc. Professor
CSE, ECE

Galvanauskas, Almantas
Professor
ECE

García-Ramirez, Héctor
Lecturer I
CSE

Genkin, Daniel
Asst. Professor
CSE

Gianchandani, Yogesh B.
Professor
Prof. (courtesy), AP; ME; Director, Center for Wireless Integrated MicroSensing & Systems
ECE

Gilchrist, Brian E.
Professor.
Director, SPRL/XTRM Labs; Prof. (courtesy), CLASP; AP
ECE

Graetz, Emily
Lecturer I
CSE

Grbic, Anthony
Professor
Prof. (courtesy), AP
ECE

Gregg, Robert
Associate Professor
ECE

Griffin, Brent
Asst. Research Scientist
ECE

Grizzle, Jessy W.
Elmer G. Gilbert Dist. Univ. Prof.; J.W. and C. L. Levin Prof.; Director, Robotics; Prof. (courtesy), ME
ECE

Guo, Lingjie
Professor
Prof. (courtesy), MACRO, ME, AP
ECE

Guzdial, Mark
Professor
CSE

Halderman, J. Alex
Professor
CSE

Hamilton, Nicole
Lecturer III
CSE

Hayes, John P.
Claude E. Shannon Professor of Engineering Science
CSE, ECE

He, Guohong
Asst. Research Scientist
ECE

Hero III, Alfred O.
John H. Holland Dist. Univ. Prof.; R.J. and B. Williams Prof.; Prof. (courtesy), BME, STATS
ECE, CSE

Hiskens, Ian A.
Vennema Professor of Engineering
ECE

Hofmann, Heath F.
Professor
Assoc. Chair of ECE Graduate Affairs
ECE

Honeyman, Peter
Research Professor and Lecturer
CSE

Islam, Mohammed N.
Professor
Prof. (courtesy), BME, IntMed
ECE

Jagadish, HV
Bernard A. Galler Collegiate Professor of EECS; Director, Michigan Institute for Data Science
CSE

Jamin, Sugih
Assoc. Professor
CSE

Jenkins, Odest Chadwicke
Assoc. Professor
CSE

Johnson, Justin
Asst. Professor
CSE

Juett, James
Lecturer III
CSE

Kamil, Amir
Lecturer IV
CSE

Kanicki, Jerzy
Professor
Prof. (courtesy), AP
ECE

Kapritsos, Manos
Asst. Professor
CSE

Kasikci, Baris
Asst. Professor
CSE

Kieras, David E.
Professor
Prof. (courtesy), PSYCH
CSE

Kim, Hun-Seok
Asst. Professor
ECE

Kira, Mackillo
Professor
ECE

Kloosterman, John
Lecturer III
CSE

Koutra, Danai
Asst. Professor; Asst. Prof. (courtesy) CMB
CSE

Ku, Pei-Cheng
Assoc. Professor; Assoc. Chair for Undergraduate ECE Affairs; Assoc. Prof. (courtesy), AP, MACRO
ECE

Kuipers, Benjamin
Professor
CSE

Kushner, Mark J.
George I. Haddad Professor of EECS; Director, Michigan Institute for Plasma Science and Engineering; Prof. (courtesy), AP, ChemE, NERS
ECE

Kutty, Sindhu
Lecturer III
CSE

Lafortune, Stéphane
N. Harris McClamroch Professor of EECS
ECE, CSE

Laird, John E.
John L. Tishman Professor of Engineering
CSE

Lasecki, Walter
Asst. Professor; Asst. Prof. (courtesy), SI
CSE

Lee, Honglak
Assoc. Professor
CSE

Lee, In Hee
Asst. Research Scientist
ECE

Lee, Somin Eunice
Asst. Professor; Asst. Prof. (courtesy) BME
ECE

Lim, Jaechan
Asst. Research Scientist
ECE

Liu, Mingyan
Peter and Evelyn Fuss Chair of ECE; Professor
ECE, CSE

Lu, Wei
Professor
Prof. (courtesy), AP, MSE
ECE

Madhyastha, Harsha
Assoc. Professor
CSE

Mahdavifar, Hessam
Asst. Professor
ECE

Mahlke, Scott
Professor
CSE

Maksimchuk, Anatoly
Research Scientist
ECE

Mao, Z. Morley
Professor
CSE

Mars, Jason
Assoc. Professor
CSE

Mathieu, Johanna
Asst. Professor
ECE

Mazumder, Pinaki
Professor
CSE, ECE

Meerkov, Semyon M.
Professor
ECE

Mi, Zetian
Professor
ECE

Michielssen, Eric
L.G. Johnson Professor;
Assoc. VP for Adv.
Research Computing;
ECE

Mihalcea, Rada
Professor
CSE

Morgan, Andrew
Lecturer II
CSE

Mower Provost, Emily
Assoc. Professor
CSE

Mortazawi, Amir
Professor
ECE

Mozafari, Barzan
Assoc. Professor
CSE

Mudge, Trevor
Bredt Family Professor
of Engineering
CSE, ECE

Muniz, Rodrigo A.
Research Investigator
ECE

Nadakuditi, Rajesh Rao
Assoc. Professor;
Assoc. Prof. (courtesy), AP
ECE

Najafi, Khalil
Schlumberger Prof.
of Engineering;
Arthur F. Thurnau Professor
Prof. (courtesy), BME
ECE

Narayanasamy, Satish
Assoc. Professor
CSE

Nashashibi, Adib Y.
Assoc. Research
Scientist
ECE

Nees, John
Assoc. Research
Scientist
ECE

Noble, Brian
Chair of CSE;
Professor
CSE

Norris, Theodore B.
Gérard A. Mourou
Professor of EECS;
Prof. (courtesy), AP
ECE

Olson, Edwin
Assoc. Professor
CSE

Omar, Cyrus
Asst. Professor
CSE

Ozay, Necmiye
Assoc. Professor
ECE

Paoletti, David R.
Lecturer IV
CSE

Peikert, Christopher
Patrick C. Fischer
Development Professor in
Theoretical Computer Science
CSE

Perez-Rosas, Veronica
Asst. Research Scientist
CSE

Peterson, Rebecca L.
Assoc. Professor;
Assoc. Prof. (courtesy), AP
ECE

Pettie, Seth
Professor
Assoc. Chair
CSE

Phillips, Jamie D.
Arthur F. Thurnau Professor;
Director, Lurie Nanofabrication
Facility
Prof. (courtesy), AP
ECE

Pierce, Leland E.
Assoc. Research Scientist
ECE

Pradhan, S. Sandeep
Professor
ECE

Prakash, Atul
Professor
CSE

Qin, Yutao
Asst. Research Scientist
ECE

Rampazzi, Sara
Research Investigator
CSE

Rand, Stephen C.
Director, Center for Dynamic Magneto-Optics (DYNAMO);
Professor, EECS;
Prof. (courtesy), PHY, AP
ECE

Revzen, Shai
Assoc. Professor;
Assoc. Prof. (courtesy), EEB
ECE

Ringenberg, Jeffrey S.
Lecturer IV
CSE

Sakallah, Karem A.
Professor
CSE, ECE

Sample, Alanson
Assoc. Professor
CSE

Sarabandi, Kamal
Rufus S. Teesdale Professor of Engineering;
Director, Center for Microwave Sensor Technology
ECE

Sarabi, Armin
Asst. Research Scientist
ECE

Scott, Clayton
Professor;
Prof. (courtesy), STATS
ECE

Seymour, John
Asst. Research Scientist
ECE

Shin, Kang G.
Kevin and Nancy O'Connor Professor of Computer Science
CSE, ECE

Soloway, Elliot
Arthur F. Thurnau Professor
Prof. (courtesy), SI, SOE
CSE

Stark, Wayne E.
Professor
ECE

Steel, Duncan G.
Robert J. Hiller Professor of EECS;
Prof. (courtesy), BioPHY, PHY, IOG, AP
ECE

Stout, Quentin F.
Professor
Co-Director, Center for Space Environment Modeling;
Prof. (courtesy), CLASP
CSE

Subramanian, Vijay
Assoc. Professor
ECE

Sylvester, Dennis
Professor
Sr. Assoc. Chair
ECE

Tang, Lingjia
Asst. Professor
CSE

Terry, Fred L.
Professor;
Director, CoE First Year Programs;
Prof. (courtesy), AP
ECE

Tsang, Leung
Professor
ECE

Ulaby, Fawwaz T.
Emmett Leith Dist. Univ. Professor;
Arthur F. Thurnau Professor
ECE

Volkovich, Ilya
Lecturer III
CSE

Wakefield, Gregory H.
Assoc. Professor;
Assoc. Prof. (courtesy), SMTD, OTO
ECE, CSE

Weimer, Westley
Professor
CSE

Wellman, Michael P.
Lynn A. Conway Professor of CSE; Assoc. Dean for Academic Affairs
CSE

Wenisch, Thomas F.
Professor
CSE

Wentzloff, David D.
Assoc. Professor
ECE

Whitaker, John F.
Research Scientist
ECE

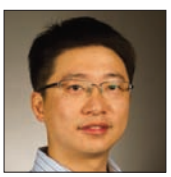
Wiens, Jenna
Asst. Professor
Co-director, Precision Health
CSE

Willingale, Louise
Asst. Professor
ECE

Winful, Herbert G.
Joseph E. and Anne P. Rowe Professor
Arthur F. Thurnau Professor
ECE

Woo, Jong-Kwan
Asst. Research Scientist
ECE

Yarger, Austin
Lecturer I
CSE



Ying, Lei
Professor
ECE

Yoon, Euisik
Professor
Prof. (courtesy), BME
ECE

Zhang, Zhengya
Assoc. Professor
ECE

Zhong, Zhaohui
Assoc. Professor
ECE

AFFILIATED FACULTY

Abney, Steve, Assoc. Professor, *LING, CSE*

Adar, Eytan, Assoc. Professor, *SI, CSE*

Atkins, Ella, Professor, *AERO, CSE, ECE*

Budak, Ceren, Asst. Professor, *SI, CSE*

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Chestek, Cynthia, Assoc. Profess*or, BME, ECE*

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AERO – Aerospace Engineering
AP – Applied Physics
BioPHY – BioPhysics
BME – Biomedical Engineering
CEE – Civil and Environmental Engineering
ChemE – Chemical Engineering
CLASP – Climate and Space Sciences and Engineering
CSE – Computer Science and Engineering
CMB – Computational Medicine and Bioinformatics
ECE – Electrical and Computer Engineering
EEB – Ecology and Evolutionary Biology
IntMed – Internal Medicine
IOE – Industrial and Operations Engineering
IOG – Institute of Gerontology
OP – Office of the President
ISR – Institute for Social Research
LHS – Learning Health Sciences
LING – Linguistics
MACRO – Macromolecular Science and Engineering
MATH – Mathematics
ME – Mechanical Engineering
MSE – Materials Science and Engineering
NAME – Naval Architecture and Marine Engineering
NERS – Nuclear Engineering and Radiological Sciences
OTO – Otolaryngology
PHIL – Philosophy
PHY – Physics
PSYCH – Psychology
RAD – Radiology
SI – School of Information
SMTD – School of Music, Theatre & Dance
SOE – School of Education
STATS – Statistics

The Big House in the late 1970s.
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